

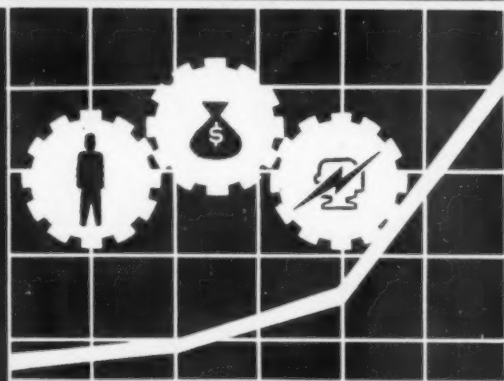
SEPTEMBER 1955
FIFTY-FOURTH YEAR

ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING

Lighting maintenance — economical methods of lamp replacement and cleaning schedules.

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Growth — the basic dimension and long range prospects of electrical construction — a special editorial report.

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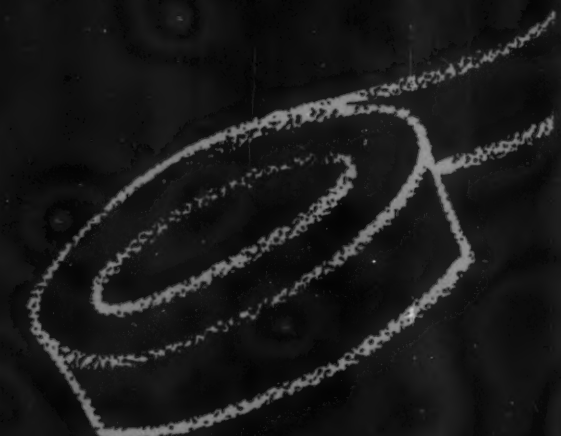
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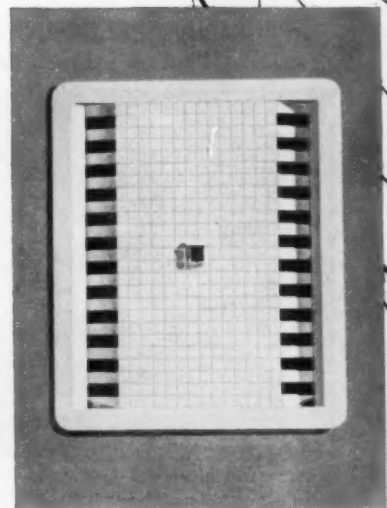
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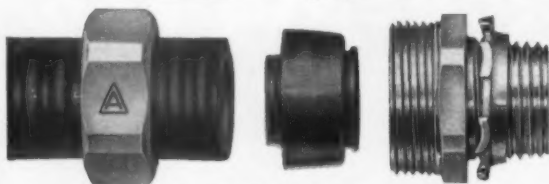
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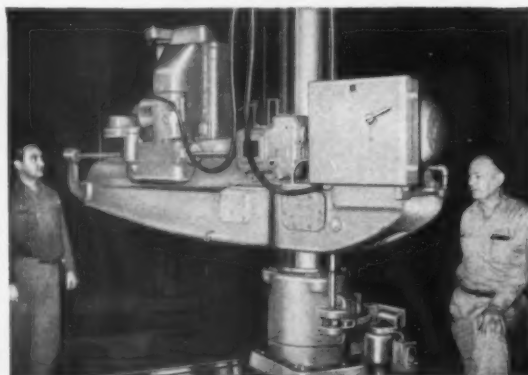
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September 1955

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Sidelights

BASIC DIMENSIONS—What are the long range prospects for electrical construction, installation and maintenance? The answers are especially important in a "growth" industry. They are essential to good corporate planning.

Prospects are best indicated by a study of the significant indexes of past performance and the growth pattern they show. Available statistics can disclose some particular segments of the pattern. But the industry is broad and complex and concerned with many parts of the total economy.

Eastern Editor B. C. Cooper has drawn on the statistical resources of government and industry for the basic measurements and factors affecting the growth of the industry. "Electrical Industry Growth Paces Booming Economy", beginning on page 91, is our first annual statistical summary devoted to long range industry prospects.

FLOOD DISASTER—Hurricane Diane passed slowly over Pennsylvania and New York on August 18-19. Its great winds had diminished until they were no longer dangerous. Far out on the circumference of the counterclockwise storm, humid air from the mid-summer Atlantic was drawn inland then sharply upward over chill mountains.

The rains came. Within a few hours ten and more inches of rain fell on

the upper watersheds of Massachusetts, Connecticut, Eastern New York, Eastern Pennsylvania and New Jersey. The run-off turned mountain streams into raging rivers. Highways, railroads and power lines were washed out.

As this is written the task of rehabilitation has not yet begun. By all available appraisals, damage is the greatest in the history of the Northeast.

Even when power distribution is restored the wiring systems of factories, stores and homes have to test safe or be rewired before they can be energized. Motors and apparatus have to be cleaned, dried and re-insulated or replaced. Oil burners, ignition transformers, gas burner solenoids and fluorescent lighting ballasts almost always require replacement.

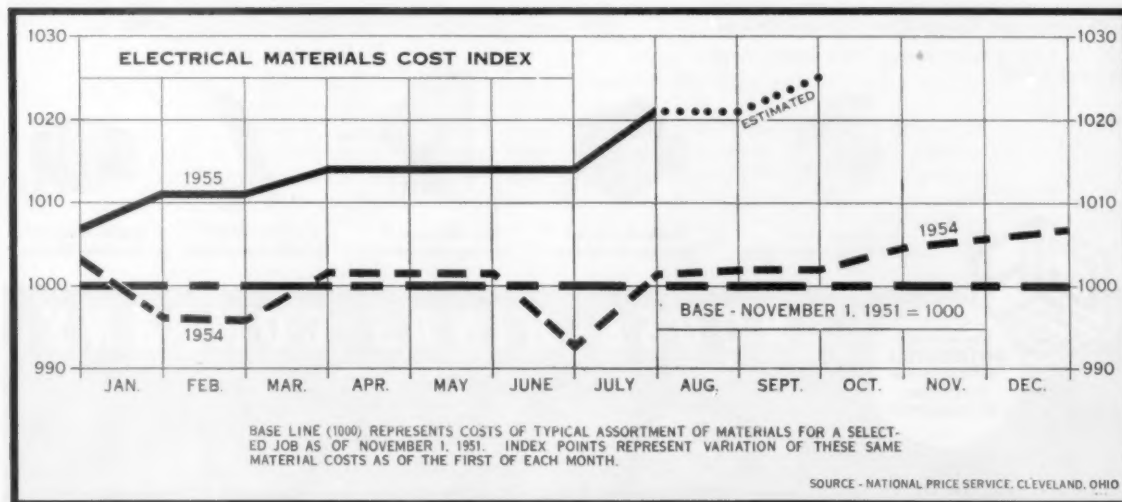
All this takes an enormous amount of skilled and exacting work by expert mechanics. The urgent needs of the wide area of disaster will call for one of the greatest electrical industry efforts of all time.

SELF-POWERED SHOW — The Powerama, a gigantic show of General Motors diesel engines staged on a 23-acre site on Chicago's lake-front is entirely self-powered. Four 1000-kw mobile engine-generator sets provide 4,160-volt energy for the tremendous lighting and power loads. Underground distribution is carried in 60,000 ft of

plastic conduit. J. F. Fisher Co., Chicago electrical contractors, handled the electrical installation, a description of the unusual project by midwest editor, Gus Eckel, begins on page 121.

TEXAS-SIZE MODERNIZATION—Electrical modernization of the Sam Houston Coliseum, Houston, Texas, involved two new 3000-amp 480-volt feeders to a two-section switchboard; complete relighting, balcony escalator, and 1200 tons of air conditioning. "Modernizing a Convention Hall", page 107, gives the details of the installation which contains many practical features applicable to other convention halls, exhibitions, sports arenas and similar interiors.

SOUND—The third and concluding part of the three-part article, "Sound Systems", by Sumberg and McPartland begins on page 114. Covering connectors, wires, cables and installation techniques, this portion of the series will be particularly useful to the engineer and estimator who must lay out sound systems and figure the raceway, cable and terminal requirements. From research in the course of preparation, we believe that this is the first comprehensive treatment of the subject published which covers the essentials of sound system installations in the context of commercial electrical wiring system practice.



New



NO AIR PRESSURE NEEDED! Type EVA contains the explosion rather than preventing it: no "pumping up" required. Re-lamp right in hazardous areas: just switch off circuit, unscrew globe holder and replace lamp. No pressure switch to fail and create possibilities for hazard. Low initial cost and simple maintenance will mean sustained performance at top economy with these new Crouse-Hinds lighting fixtures. 200 W; with or without guard or reflector; overall length, 13 $\frac{3}{4}$ ".

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CONDULETS • FLOODLIGHTS • TRAFFIC SIGNALS • AIRPORT LIGHTING

Washington Report

The fast business pace maintained through the summer without the usual dip, Commerce Dept. reported, as expanding credit offered strong support. FHA and VA tightened home loan credit terms, and FRB raised bank loan rates, while trade groups and economists cautioned auto dealers, appliance and furniture retailers and others to get higher down payments, shorter maturities on time payment sales.

Also bolstering the business pace was the quick wage settlements between unions and the auto, steel, and other industries. Maintenance of production schedules, at higher labor rates, has kept personal income at a high level, raised employment to a peak of 65 million in July, bolstered consumer spending plans, is now upping prices in spite of keener competition.

Cost of living rose in July for the second straight monthly gain, as measured by BLS's Consumer Price Index. It stood at 114.7 (1947-49=100) in July, up from 114.4 in June, and 114.3 in July 1954. Since October 1953 it has fluctuated between 114.2 and 115.2.

Copper scarcity is being felt throughout the U. S., is expected to stay in tight supply for several months, was partially responsible for price hike to 40 cents a pound in mid-August. Scarcity was caused by growing world demand plus crippling domestic strikes in July and early August. Higher wages to striking miners helped push up price. The hike will not provide any more metal, but brings domestic price more in line with premium rates already being paid by fabricators, and with London's recent 47.4 cents a pound.

Aluminum demand is also soaring even with output hitting in excess of 1.5 million tons a year rate, double the 1950 rate, or the wartime peak.

Steel production is closing in on 1953's record, with 66.3 million tons for 1955's first seven months as compared with 67.2 million tons two years earlier. July output was 9,110,000 tons, 40% ahead of a year earlier.

Nickel has been critically short this year, so much so that ODM has diverted 12 million pounds to industrial users from the defense stockpile.

Nation's stockpile of strategic and critical materials will be completed in another two years, ODM has reported. Sharpest pinch currently is on aluminum, copper and nickel. ODM also reported plans for wartime controls over production, prices, wages, communications and transportation are in various stages of development. Rationing plans are also under study.

Storm and flood damage wreaked by Hurricane Diane in the Northeast apparently dealt industry its hardest blow in the brass fabrication field. Plants responsible for about a third of the nation's brass production, concentrated in hard-hit Connecticut, suffered severe damage, with many knocked out of production for several weeks.

Federal agencies moved in quickly to provide emergency and financial aid. Breaking into his vacation trip to Denver, President Eisenhower flew to the Northeast to inspect the damage firsthand, ordered Federal Civil Defense Administration to provide emergency assistance in restoring vital Government and public services to all designated "major disaster areas". American Red Cross provided victims with emergency food, clothing, shelter, medicine, etc. Army Engineers brought in power generators, the Signal Corps helped restore communications. Small Business Administration, Federal Housing Administration and Farmers Home Administration all moved in to provide financial aid in the form of loans for rebuilding, repairs of flood damage, and rehabilitation of industrial plants and commercial establishments.

**"We
eliminated Motor
Burnouts and cut
new installation
costs — by using
Fusetron dual-
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"Our organization services some 43 Alfalfa Mills in the central Nebraska area.

"We know, from experience, that overloads and single phasing are two of the most common causes for motor failures in these mills.

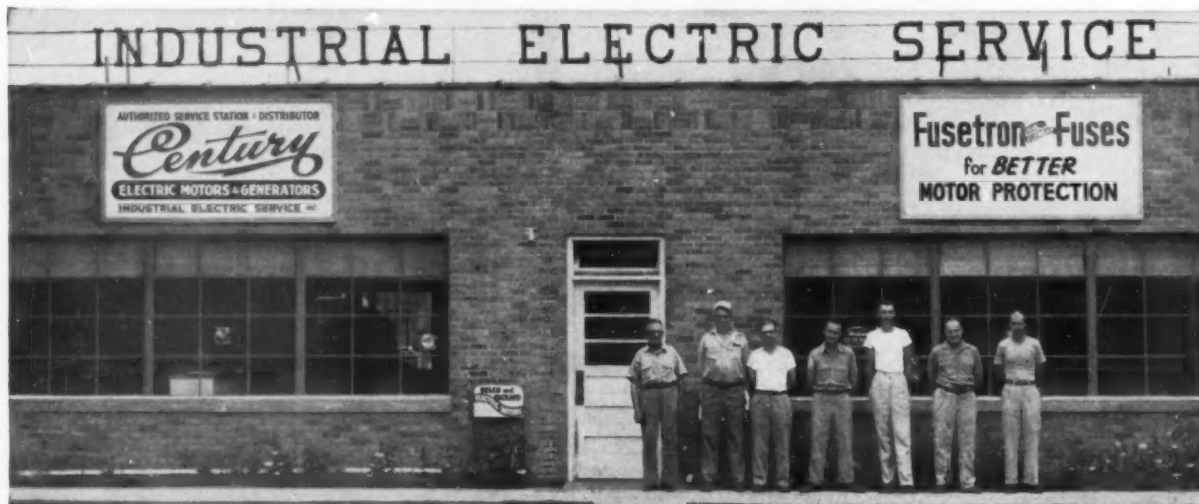
"In order to give these motors the protection they need, we use Fusetron fuses in motor-running protection sizes. As a result, we have eliminated motor burnouts for our customers.

"In addition, on new installations, we have found that smaller switches can be used with proper size Fusetron fuses.

"We can pass this substantial saving along to our customers and still give them safer protection than can be had with ordinary protective devices."

Max T. Moore, Vice-President

Industrial Electric Service, Inc.
Kearney, Nebraska



**Here's why Fusetron dual-element fuses
give DOUBLE protection to large motors**

Of course, large motors are protected with thermal cutouts or overload relays. But experience has shown that such devices sometimes stick or fail to operate. When they do, the motor burns out.

On normal installations, by replacing fuses used for short-circuit protection with Fusetron fuses of motor-running protection size, you get the same short-circuit protection PLUS double protection against motor burnout from overload or single phasing.

If thermals or relays fail to operate for any reason, the Fusetron fuses will act independently to **SAVE THE MOTOR.**

**And Fusetron fuses protect against waste of
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size panels and switches.**

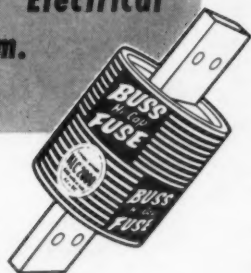
On motor circuits Fusetron fuses can be used in sizes near to the operating load. That cannot be done with ordinary fuses. It is possible with Fusetron fuses because they have a tremendous time-lag that prevents them from opening on starting currents or other harmless overloads.

This means that on new installations for motor circuits you can save space and money because *proper* size Fusetron fuses permit using *proper* size switches and panels instead of *oversize*.

You too, can profit by the 10 point protection of Fusetron fuses



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- 2 Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation.
- 3 Protect against needless blows caused by harmless overloads.
- 4 Provide thermal protection — for panels and switches against damage from heating due to poor contact.
- 5 Protect against waste of space and money — permit use of proper size switches and panels.
- 6 Protect motors against burnout from overloads.
- 7 Give **DOUBLE** burnout protection to large motors — without extra cost.
- 8 Protect motors against burnout due to single ph. sing.
- 9 Make protection of small motors simple and inexpensive.
- 10 Protect coils, transformers and solenoids against burnout.

For more information on Fusetron fuses write for bulletin FIS.

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They have unlimited interrupting capacity to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

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FLUORESCENT RLM SPECIFICATIONS

#2	#3	#4	#18	#40	PROCESSED BY THE MANUFACTURERS who offer RLM-LABELED UNITS	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20	#21	#22	#23	#24	#25	#26	#27	#28	#29	#30	#31	#32	#33	#34	#35	#36	#37	#38	#39	#40	#41	#42	#43	#44	#45	#46	#47	#48	#49	#50	#51	#52	#53	#54	#55	#56	#57	#58	#59	#60	#61	#62	#63	#64	#65	#66	#67	#68	#69	#70	#71	#72	#73	#74	#75	#76	#77	#78	#79	#80	#81	#82	#83	#84	#85	#86	#87	#88	#89	#90	#91	#92	#93	#94	#95	#96	#97	#98	#99	#100	#101	#102	#103	#104	#105	#106	#107	#108	#109	#110	#111	#112	#113	#114	#115	#116	#117	#118	#119	#120	#121	#122	#123	#124	#125	#126	#127	#128	#129	#130	#131	#132	#133	#134	#135	#136	#137	#138	#139	#140	#141	#142	#143	#144	#145	#146	#147	#148	#149	#150	#151	#152	#153	#154	#155	#156	#157	#158	#159	#160	#161	#162	#163	#164	#165	#166	#167	#168	#169	#170	#171	#172	#173	#174	#175	#176	#177	#178	#179	#180	#181	#182	#183	#184	#185	#186	#187	#188	#189	#190	#191	#192	#193	#194	#195	#196	#197	#198	#199	#200	#201	#202	#203	#204	#205	#206	#207	#208	#209	#210	#211	#212	#213	#214	#215	#216	#217	#218	#219	#220	#221	#222	#223	#224	#225	#226	#227	#228	#229	#230	#231	#232	#233	#234	#235	#236	#237	#238	#239	#240	#241	#242	#243	#244	#245	#246	#247	#248	#249	#250	#251	#252	#253	#254	#255	#256	#257	#258	#259	#260	#261	#262	#263	#264	#265	#266	#267	#268	#269	#270	#271	#272	#273	#274	#275	#276	#277	#278	#279	#280	#281	#282	#283	#284	#285	#286	#287	#288	#289	#290	#291	#292	#293	#294	#295	#296	#297	#298	#299	#300	#301	#302	#303	#304	#305	#306	#307	#308	#309	#310	#311	#312	#313	#314	#315	#316	#317	#318	#319	#320	#321	#322	#323	#324	#325	#326	#327	#328	#329	#330	#331	#332	#333	#334	#335	#336	#337	#338	#339	#340	#341	#342	#343	#344	#345	#346	#347	#348	#349	#350	#351	#352	#353	#354	#355	#356	#357	#358	#359	#360	#361	#362	#363	#364	#365	#366	#367	#368	#369	#370	#371	#372	#373	#374	#375	#376	#377	#378	#379	#380	#381	#382	#383	#384	#385	#386	#387	#388	#389	#390	#391	#392	#393	#394	#395	#396	#397	#398	#399	#400	#401	#402	#403	#404	#405	#406	#407	#408	#409	#410	#411	#412	#413	#414	#415	#416	#417	#418	#419	#420	#421	#422	#423	#424	#425	#426	#427	#428	#429	#430	#431	#432	#433	#434	#435	#436	#437	#438	#439	#440	#441	#442	#443	#444	#445	#446	#447	#448	#449	#450	#451	#452	#453	#454	#455	#456	#457	#458	#459	#460	#461	#462	#463	#464	#465	#466	#467	#468	#469	#470	#471	#472	#473	#474	#475	#476	#477	#478	#479	#480	#481	#482	#483	#484	#485	#486	#487	#488	#489	#490	#491	#492	#493	#494	#495	#496	#497	#498	#499	#500	#501	#502	#503	#504	#505	#506	#507	#508	#509	#510	#511	#512	#513	#514	#515	#516	#517	#518	#519	#520	#521	#522	#523	#524	#525	#526	#527	#528	#529	#530	#531	#532	#533	#534	#535	#536	#537	#538	#539	#540	#541	#542	#543	#544	#545	#546	#547	#548	#549	#550	#551	#552	#553	#554	#555	#556	#557	#558	#559	#560	#561	#562	#563	#564	#565	#566	#567	#568	#569	#570	#571	#572	#573	#574	#575	#576	#577	#578	#579	#580	#581	#582	#583	#584	#585	#586	#587	#588	#589	#590	#591	#592	#593	#594	#595	#596	#597	#598	#599	#600	#601	#602	#603	#604	#605	#606	#607	#608	#609	#610	#611	#612	#613	#614	#615	#616	#617	#618	#619	#620	#621	#622	#623	#624	#625	#626	#627	#628	#629	#630	#631	#632	#633	#634	#635	#636	#637	#638	#639	#640	#641	#642	#643	#644	#645	#646	#647	#648	#649	#650	#651	#652	#653	#654	#655	#656	#657	#658	#659	#660	#661	#662	#663	#664	#665	#666	#667	#668	#669	#670	#671	#672	#673	#674	#675	#676	#677	#678	#679	#680	#681	#682	#683	#684	#685	#686	#687	#688	#689	#690	#691	#692	#693	#694	#695	#696	#697	#698	#699	#700	#701	#702	#703	#704	#705	#706	#707	#708	#709	#710	#711	#712	#713	#714	#715	#716	#717	#718	#719	#720	#721	#722	#723	#724	#725	#726	#727	#728	#729	#730	#731	#732	#733	#734	#735	#736	#737	#738	#739	#740	#741	#742	#743	#744	#745	#746	#747	#748	#749	#750	#751	#752	#753	#754	#755	#756	#757	#758	#759	#760	#761	#762	#763	#764	#765	#766	#767	#768	#769	#770	#771	#772	#773	#774	#775	#776	#777	#778	#779	#780	#781	#782	#783	#784	#785	#786	#787	#788	#789	#790	#791	#792	#793	#794	#795	#796	#797	#798	#799	#800	#801	#802	#803	#804	#805	#806	#807	#808	#809	#810	#811	#812	#813	#814	#815	#816	#817	#818	#819	#820	#821	#822	#823	#824	#825	#826	#827	#828	#829	#830	#831	#832	#833	#834	#835	#836	#837	#838	#839	#840	#841	#842	#843	#844	#845	#846	#847	#848	#849	#850	#851	#852	#853	#854	#855	#856	#857	#858	#859	#860	#861	#862	#863	#864	#865	#866	#867	#868	#869	#870	#871	#872	#873	#874	#875	#876	#877	#878	#879	#880	#881	#882	#883	#884	#885	#886	#887	#888	#889	#890	#891	#892	#893	#894	#895	#896	#897	#898	#899	#900	#901	#902	#903	#904	#905	#906	#907	#908	#909	#910	#911	#912	#913	#914	#915	#916	#917	#918	#919	#920	#921	#922	#923	#924	#925	#926	#927	#928	#929	#930	#931	#932	#933	#934	#935	#936	#937	#938	#939	#940	#941	#942	#943	#944	#945	#946	#947	#948	#949	#950	#951	#952	#953	#954	#955	#956	#957	#958	#959	#960	#961	#962	#963	#964	#965	#966	#967	#968	#969	#970	#971	#972	#973	#974	#975	#976	#977	#978	#979	#980	#981	#982	#983	#984	#985	#986	#987	#988	#989	#990	#991	#992	#993	#994	#995	#996	#997	#998	#999	#1000	#1001	#1002	#1003	#1004	#1005	#1006	#1007	#1008	#1009	#1010	#1011	#1012	#1013	#1014	#1015	#1016	#1017	#1018	#1019	#1020	#1021	#1022	#1023	#1024	#1025	#1026	#1027	#1028	#1029	#1030	#1031	#1032	#1033	#1034	#1035	#1036	#1037	#1038	#1039	#1040	#1041	#1042	#1043	#1044	#1045	#1046	#1047	#1048	#1049	#1050	#1051	#1052	#1053	#1054	#1055	#1056	#1057	#1058	#1059	#1060	#1061	#1062	#1063	#1064	#1065	#1066	#1067	#1068	#1069	#1070	#1071	#1072	#1073	#1074	#1075	#1076	#1077	#1078	#1079	#1080	#1081	#1082	#1083	#1084	#1085	#1086	#1087	#1088	#1089	#1090	#1091	#1092	#1093	#1094	#1095	#1096	#1097	#1098	#1099	#1100	#1101	#1102	#1103	#1104	#1105	#1106	#1107	#1108	#1109	#1110	#1111	#1112	#1113	#1114	#1115	#1116	#1117	#1118	#1119	#1120	#1121	#1122	#1123	#1124	#1125	#1126	#1127	#1128	#1129	#1130	#1131	#1132	#1133	#1134	#1135	#1136	#1137	#1138	#1139	#1140	#1141	#1142	#1143	#1144	#1145	#1146	#1147	#1148	#1149	#1150	#1151	#1152	#1153	#1154	#1155	#1156	#1157	#1158	#1159	#1160	#1161	#1162	#1163	#1164	#1165	#1166	#1167	#1168	#1169	#1170	#1171	#1172	#1173	#1174	#1175	#1176	#1177	#1178	#1179	#1180	#1181	#1182	#1183	#1184	#1185	#1186	#1187	#1188	#1189	#1190	#1191	#1192	#1193	#1194	#1195	#1196	#1197	#1198	#1199	#1200	#1201	#1202	#1203	#1204	#1205	#1206	#1207	#1208	#1209	#1210	#1211	#1212	#1213	#1214	#1215	#1216	#1217	#1218	#1219	#1220	#1221	#1222	#1223	#1224	#1225	#1226	#1227	#1228	#1229	#1230	#1231	#1232	#1233	#1234	#1235	#1236	#1237	#1238	#1239	#1240	#1241	#1242	#1243	#1244	#1245	#1246	#1247	#1248	#1249	#1250	#1251	#1252	#1253	#1254	#1255	#1256	#1257	#1258	#1259	#1260	#1261	#1262	#1263	#1264	#1265	#1266	#1267	#1268	#1269	#1270	#1271	#1272	#1273	#1274	#1275	#1276	#1277	#1278	#1279	#1280	#1281	#1282	#1283	#1284	#1285	#1286	#1287	#1288	#1289	#1290	#1291	#1292	#1293	#1294	#1295	#1296	#1297	#1298	#1299	#1300	#1301	#1302	#1303	#1304	#1305	#1306	#1307	#1308	#1309	#1310	#1311	#1312	#1313	#1314	#1315	#1316	#1317	#1318	#1319	#1320	#1321	#1322	#1323	#1324	#1325	#1326	#1327	#1328	#1329	#1330	#1331	#1332	#1333	#1334	#1335	#1336	#1337	#1338	#1339	#1340	#1341	#1342	#1343	#1344	#1345	#1346	#1347	#1348	#1349	#1350	#1351	#1352	#1353	#1354	#1355	#1356	#1357	#1358	#1359	#1360	#1361	#1362	#1363	#1364	#1365	#1366	#1367	#1368	#1369	#1370	#1371	#1372	#1373	#1374	#1375	#1376	#1377	#1378	#1379	#1380	#1381	#1382	#1383	#1384	#1385	#1386	#1387	#1388	#1389	#1390	#1391	#1392	#1393	#1394	#1395	#1396	#1397	#1398	#1399	#1400	#1401	#1402	#1403	#1404	#1405	#1406	#1407	#1408	#1409	#1410	#1411	#1412	#1413	#1414	#1415	#1416	#1417	#1418	#1419	#1420	#1421	#1422	#1423	#1424	#1425	#1426	#1427	#1428	#1429	#1430	#1431	#1432	#1433	#1434	#1435	#1436	#1437	#1438	#1439	#1440	#1441	#1442	#1443	#1444	#1445	#1446	#1447	#1448	#1449	#1450	#1451	#1452	#1453	#1454	#1455	#1456	#1457	#1458	#1459	#1460	#1461	#1462	#1463	#1464	#1465	#1466	#1467	#1468	#1469	#1470	#1471	#1472	#1473	#1474	#1475	#1476	#1477	#1478	#1479	#1480	#1481	#1482	#1483	#1484	#1485	#1486	#1487	#1488	#1489	#1490	#1491	#1492
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Note: Many manufacturers make incandescent RLM Units for more than one lamp size. The numerals refer to the number of different-size RLM Units which the manufacturer offers under the specification.

○ = Open End
● = Closed End

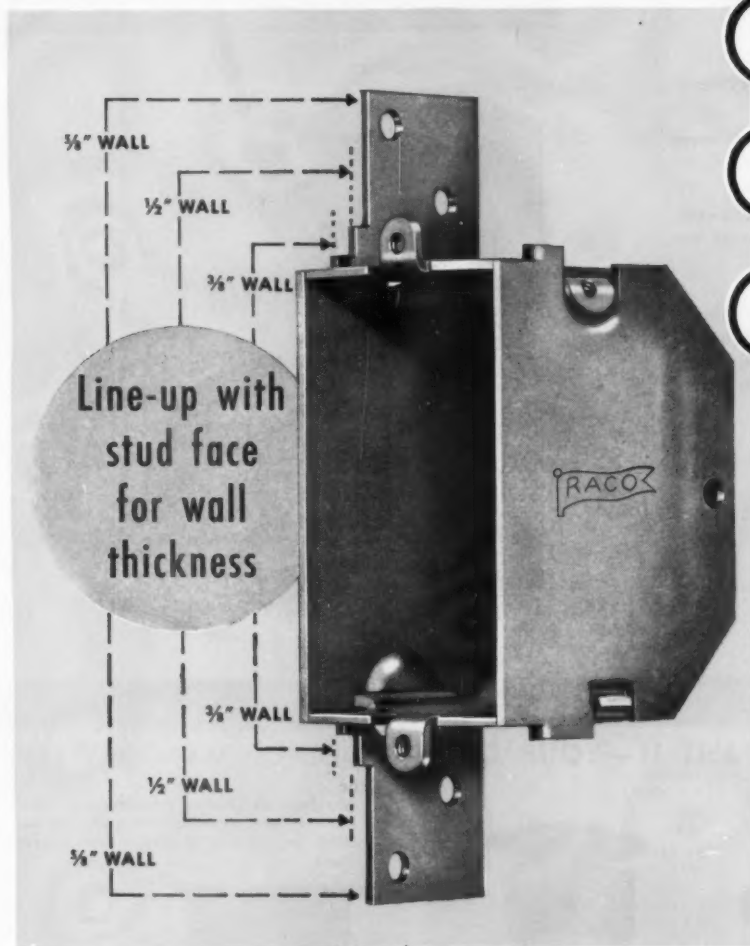


RLM STANDARDS INSTITUTE

The letters RLM stand for Reflector and Lighting Equipment Manufacturers.

ONE SWITCH BOX FOR EVERY TYPE OF WALL

NEW VERSATILE RACO #491 BOX FOR DRY WALLS! FOR PLASTER WALLS!



1

PLACE ON STUD

2

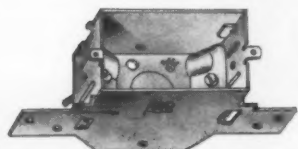
LINE UP MARKS

3

NAIL IT DOWN

INSTALLED TRUE
AND SQUARE... IN
A FEW SECONDS

Two Nails Will Hold!
Five Nails For Most
Rigid Mounting!



Bracket is integral part of box side

Save time and money on every job with this new, versatile Raco No. 491 Switch Box. Self-gauging Raco D Bracket aligns box true and square. Bracket and box are one-piece for added strength... non-gangable. A roofing nail in each end of the bracket and a 16-penny nail through the box hold it solid for installing rock-lath.

WRITE FOR FURTHER INFORMATION



"A RACO BOX FOR EVERY NEED"

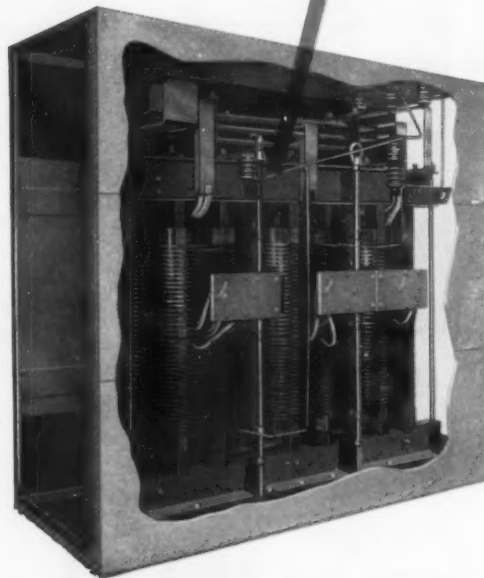
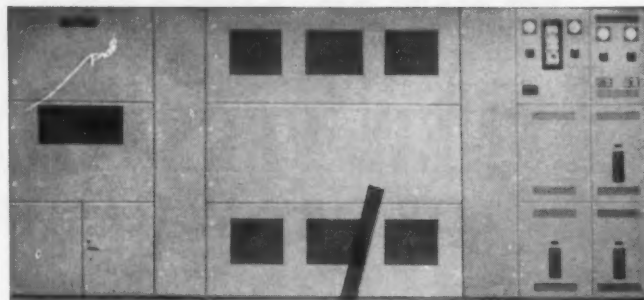
ALL-STEEL EQUIPMENT INC. Aurora, Illinois

PROTECT YOUR INVESTMENT

**Specify KUHLMAN power
center transformers —
built for dependable service —
designed for your
job specifications**

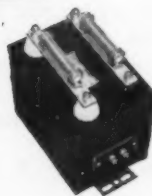
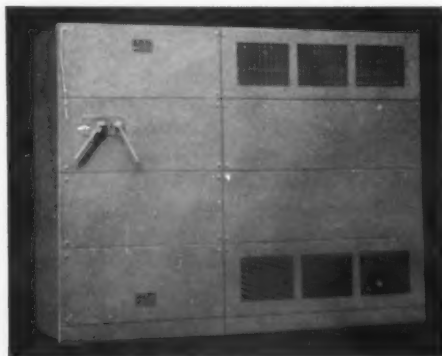
KUHLMAN Dry-Type Transformers

- Class "B" insulation is designed for a maximum 80° rise over ambient temperature of 40°C.
- Dry-Types can be supplied as core and coil units or as complete sections with sheet metal enclosures.
- All units match specified high and low voltage switchgear and can be installed close to the center of the load areas, thus providing better voltage regulation and eliminating long secondary runs of copper.
- Standard assemblies can be used as either right or left hand units.
- Taps are conveniently located.
- Automatic forced air cooling can be provided for additional over-load capacity.



PUT POWER WHERE YOU WANT IT—YOUR CHOICE OF KUHLMAN DRY-TYPE

Dry-type Power center for supplying power to individual production machines—reduces line losses and voltage drops—is installed at machine location.



Potential and current transformers for operating relays, tripping devices, and metering applications.

Dry-Type distribution transformers, either floor or wall mounted—600 volts and below, for machine tools and lighting circuits.

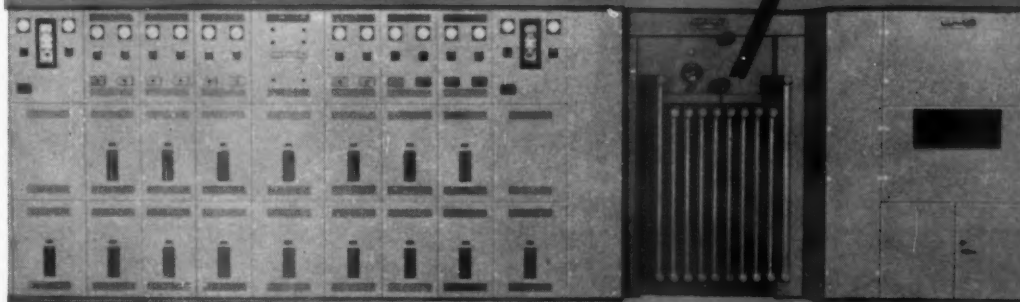
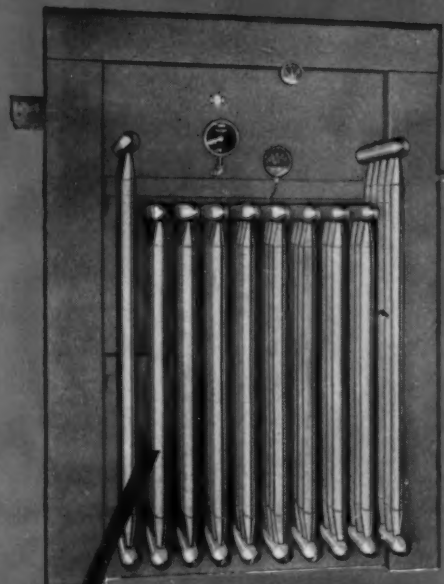


KUHLMAN ELECTRIC CO. BAY CITY, MICH. • CRYSTAL SPRINGS, MISS.

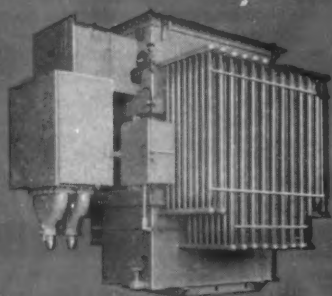
IN MODERN PLANT EQUIPMENT

KUHLMAN Liquid-filled Transformers

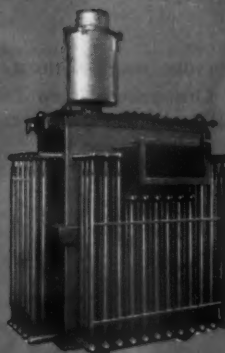
- Standard accessories on all units include: ground pad, tap changer and handle, name plate, magnetic liquid level gauge, top filter valve, liquid temperature indicator, drain valve, pressure vacuum gauge, and jack bosses.
- Special accessories include: Provisions for fans and forced air cooling, alarm contacts for temperature, pressure, and liquid level gas absorber and other special equipment.
- Where required units are supplied with a safe, non-inflammable cooling fluid and can be installed without vault protection.
- Kuhlman liquid-filled transformers are designed to match the specified low and high voltage switchgear for either flush end or throat connections.
- Units are compact for easy installation and quick plant change-overs.



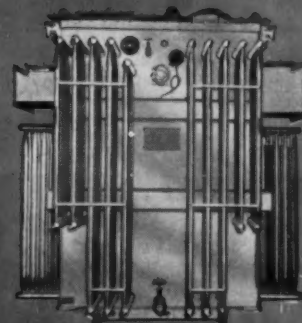
OR LIQUID-FILLED TRANSFORMERS FOR EVERY JOB APPLICATION



Typical outdoor liquid-filled transformer equipped with high voltage switches serves as a power center for distribution systems.



Liquid-filled unit equipped with a gas absorber and a relief device for relieving abnormal pressures.



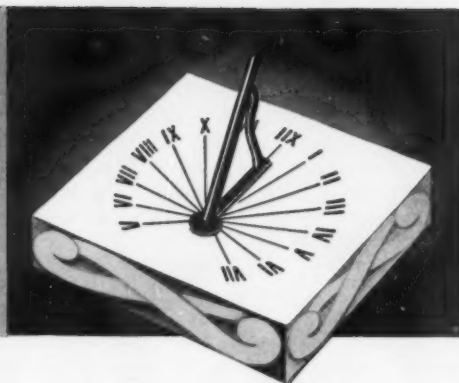
Liquid-filled unit with throats for indoor or outdoor installation in locations where transformers are throat connected to switch-gear sections or bus.

SALINAS, CALIFORNIA

170

QUALITY

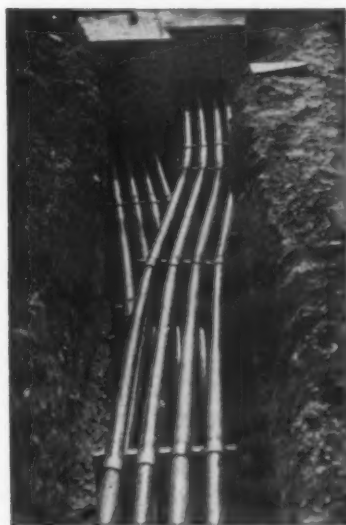
...proved by TIME...



Of course the most convincing proof of Orangeburg's enduring quality is its 62-year record of service to leading Public Utilities, Municipalities and Contractors.

Quality stands out in every feature.
Orangeburg Fibre Conduit is lightweight

yet strong, tough and resilient. Its impermeable walls and tight joints keep out corrosive ground waters. Its smooth bore and low coefficient of friction protect cable sheaths from abrasion. Orangeburg material resists acids, alkalies, salt, grease and oil.



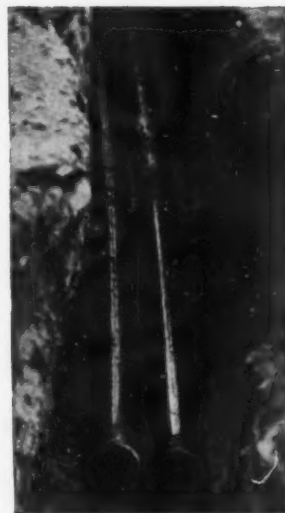
ORANGEBURG STANDARD is installed with concrete encasement. Preferred for banks of three or more ducts.

For these and other advantages Orangeburg provides complete security for electrical services underground. Result...no interruption of power. These vital services keep flowing.

SAVES MONEY, TOO!

Saves by prolonging cable life... by faster and easier handling, tooling and laying... and by the use of Orangeburg's standard fittings. They cut costs by simplifying installation. Send to Dept. EC-95 for more facts.

ORANGEBURG MANUFACTURING CO., INC.
Orangeburg, New York
West Coast Plant — Newark, California



ORANGEBURG NOCRETE is installed without concrete encasement. Extra heavy wall for direct burial.

ORANGEBURG®
FIBRE CONDUIT

STANDARD INSTALLED WITH CONCRETE

NOCRETE INSTALLED WITHOUT CONCRETE

Graybar
ELECTRIC COMPANY

DISTRIBUTORS,
ORANGEBURG
FIBRE CONDUIT

BRANCHES AND STOCKS IN PRINCIPAL CITIES

GENERAL ELECTRIC
SUPPLY COMPANY

A DIVISION OF GENERAL ELECTRIC DISTRIBUTING CORPORATION

**Expert
at work ...**



... Using the Finest Electrical Insulating

Dutch Brand

Products Made ...

DUTCH BRAND PLASTIC ELECTRICAL TAPES

Thin, strong, flexible with unusual resistance to destructive elements. Three thicknesses: .007", .010", .020".

DUTCH BRAND VINYL COLOR TAPE

Nine colors, four widths for all insulating, coding, indexing. U. L. listed.

DUTCH BRAND RUBBER TAPE

The finest tape of its kind. Resists up to 18,000 volts through a single thickness.

DUTCH BRAND FRICTION TAPE

An industry favorite for over 40 years. For perfect adhesion, for longest life choose Dutch Brand.

"DB" WIRE CONNECTORS

Get full insulation protection from these vibration-proof, weatherproof long skirt connectors.

Get the Best ... ask for Dutch Brand

Throughout industry Dutch Brand Tapes have earned the top reputation. Why? Because they are made to do the best job. They start with the finest raw materials and process them at every step with the greatest care and skill. The result is a finished product that exceeds the specifications and standards of the industry. Ask your suppliers for Dutch Brand. You are paying for the best—so be sure you're getting it.



Johns-Manville

**DUTCH BRAND
P R O D U C T S**

7800 WOODLAWN AVENUE - CHICAGO 19, ILL.

This New Exclusive Republic Feature



ARROWS ON THE NEW REPUBLIC BENDER line up with new Guide Line on Republic "Inch-Marked" E.M.T. With tubing and "Inch-Marks" lined up, electricians can easily make a smooth, accurate bend.



WHEN YOU GET A "WOW", here's what happens. Bend is smooth, but out of line. With the new Guide Line, bends can be pre-planned, made accurately, right on the job.

REPUBLIC STEEL CORPORATION
Steel and Tubes Division
212 East 131st Street
Cleveland 8, Ohio



Please send me more information on Republic ELECTRU-NITE E.M.T.

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

K-5095



brings you more savings on E.M.T. installations

The "Guide Line" that eliminates "wows".

Now on all popular sizes of

Republic "Inch-Marked" E.M.T.

The new line down that tube means your electricians can *plan* the most accurate bends you've ever seen *before* they make them. It means no more out-of-line bends. And the new Republic Bender has built-in marks to line up the tubing so that journeymen just can't miss.

Add this new feature to "Inch-Marks", easy bending, easy wire-pulling because of inside-knurling, no lines to turn, and you can see how you can save on installation when you use Republic "Inch-Marked" E.M.T. Use it on your next job. And when you ask your distributor for it, don't just say "E.M.T." Ask for Republic "Inch-Marked®" E.M.T. The E.M.T. with the new Guide Line.

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products



Complete Signaling Systems from One Responsible Source



Electrical signaling systems usually consist of a number of different components which, when electrically connected, form a complete operating system. For example, Clock and Program Bell Systems for schools often comprise a program time instrument, a central clock-resetting device, a manually-operated cross-connecting bell control board, indoor and outdoor audible signals such as bells, buzzers and horns, and dual-motored clocks of various styles. The Fire Alarm and Intercommunicating Telephone Systems for schools are just as diverse in their components.

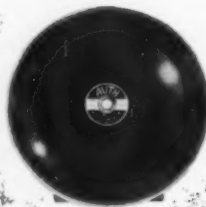
Likewise, the signaling systems which comprise the nerve centers of hospitals, housing projects, industrial plants and commercial establishments all consist of many different components electrically connected to perform their necessary, and often vital, functions.

The importance of securing all components of a system from one responsible source is obvious. To the architect, engineer, distributor and electrical contractor it means the ability to specify, purchase and install with the utmost confidence and with a minimum of effort and expense. To the owner it means standardization of equipment with consequent ease of maintenance.

The Auth Electric Company has been a responsible manufacturer of signaling systems for many years. It supplies all the necessary components for the installation of complete systems; also, all required specification and engineering data. Your nearest Auth office will be glad to give you information on Auth Signaling Systems, or you may write directly to the **Auth Electric Company, Inc., 34-20 45th St., Long Island City 1, New York.**



FOREMOST IN THE DESIGN AND MANUFACTURE OF ELECTRICAL SIGNALING, COMMUNICATION, TIME, AND PROTECTIVE EQUIPMENT FOR SCHOOLS, HOSPITALS, HOUSING, OFFICES, SHIPS, AND INDUSTRY.



Complete Systems for Hospitals
Nurse's Call, Vokacall (Audio-Visual), Doctors' In & Out, Doctors' Paging, Fire Alarm, Synchronous Clock, Intercom Telephone, and Return Call (For Nurses' Home). Also night lights.



Complete Systems for Schools
Clock and Program Bell, Fire Alarm, Intercom Telephone, and Miscellaneous.



Complete Systems for Industry
Bell, Intercom Telephone, Fire Alarm, Annunciator, and Synchronous Clock.



Complete Systems for Housing
Apartment Telephone and Flush Bell. Also Apartment Mail Boxes and Non-Electric Door Chimes.



Easy to install
Easy to extend
Easy to relocate

National Electric Busway

Provides plenty of power where it's needed

National Electric Busways are designed to meet today's industrial requirements, yet provide capacity for future expansion.

Streamlined, compact, they're designed to permit the most economical, convenient, flexible and salvable layout possible.

NE "Lo-Loss" Feeder Busway

- * Designed for current transmission up to 4000 amperes at 600 volts or less.
- * Easy to install because single bolt connectors are used to join sections. Joints are silver-plated.
- * Compact—Requires only 50% of the area needed for conduit and cable installations.
- * On vertical installations, exclusive self-contained insulator support frame carries entire weight of bus bars independent of housing.
- * Simple, accessible bolted connections which allow for quick and easy installation.

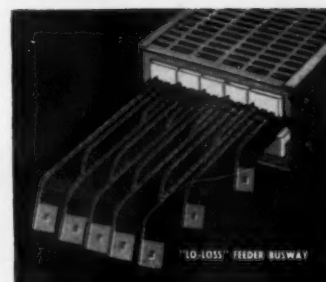
- * Bus bars insulated with Fibron plastic tape. High dielectric strength and heat resistance.

NE "Plug-In" Busway

- * Rolled edge copper bus bars.
- * All bus bar ends are silver-plated.
- * Simplified, sliding type "plug-in" opening doors. No removable parts or springs.
- * Natural gray finish baked to a hard surface inside and out.
- * Insulators supported in a sturdy 12 gauge steel channel frame withstand rough handling during shipment.

For remodeling or new construction of commercial or industrial buildings, you'll find it will pay you to send for complete information on NE Busways today.

Listed by Underwriters' Laboratories, Inc.



National Electric Products

PITTSBURGH, PA.

3 Plants • 10 Warehouses • 36 Sales Offices





INDOOR

I-T-E, single source of supply for complete Unit Substations

You can buy a unit substation either of two ways: a piece at a time (the expensive way), or all at once (the economical way). I-T-E can sell you the individual elements, but recommends that substations be purchased complete, and from a single source of supply.

This way, you get more value from I-T-E's engineering assistance in over-all planning. The unit substation, including primary breakers or switches, liquid or dry type transformers, and secondary distribution switchgear with air circuit breakers, is assembled, tested and shipped

as a unit ready for immediate installation. You have one dependable company that stands behind your complete installation.

I-T-E Primary and Secondary Unit Substations can be supplied for any application indoor or outdoor, and in any standard rating. For details, contact the I-T-E sales office nearest you. Look in your classified directory under "Electric Equipment." I-T-E Circuit Breaker Company, Switchgear Division, 19th & Hamilton Sts., Philadelphia 30, Pa.



I-T-E CIRCUIT BREAKER COMPANY, Switchgear Division



OUTDOOR

BALTRIC

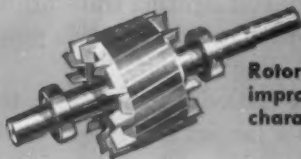
the motor that doesn't waste an ounce or an inch

The *Streamcooled Baltric* line of totally enclosed motors is *new and better*... because it is more compact, more efficient, lighter. Using modern materials and knowledge... improvements that boost efficiency and trim poundage... new insulation... permitting us to build compact power packages that do more work for their size and weight than outdated models of similar ratings.

These powerful, rugged new *Streamcooled Baltric Motors* will do a better job for you. Their compact size and lightness make them easier to handle and install. Their advanced design and high efficiency will deliver years of satisfactory service.



Exclusive Unicast Stator Frame . . . More power . . . lower losses . . . quieter



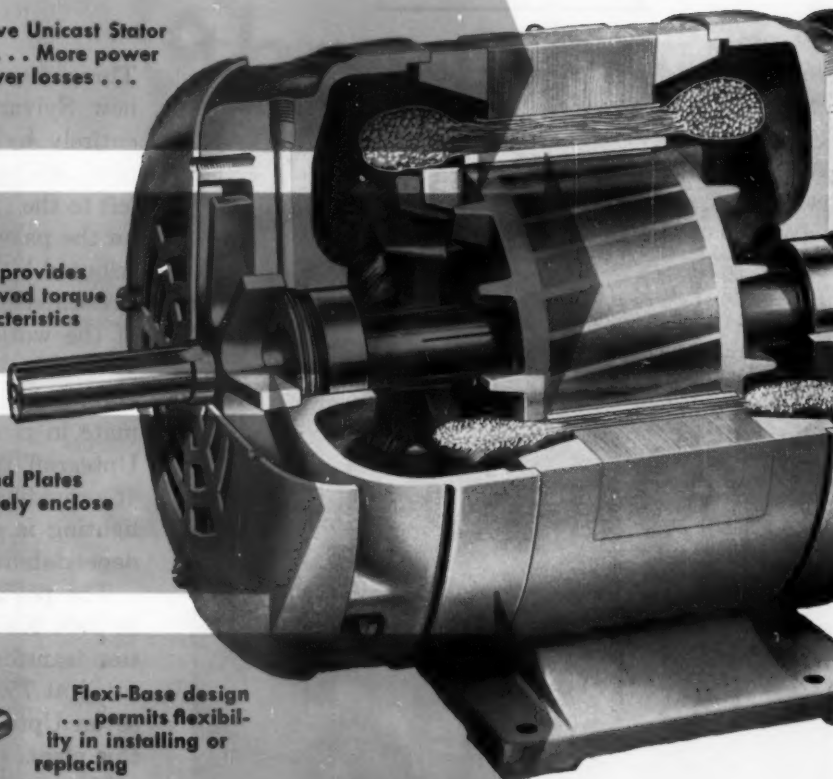
Rotor provides improved torque characteristics



Solid End Plates completely enclose motor



Flexi-Base design . . . permits flexibility in installing or replacing



Don't waste weight and space... use the motors that pack a heavyweight punch in bantam size... *Baltric*.

DESS-4

Original *Streamcooled Motors* Also Available — Built to Former NEMA Standards

ALL BALTRIC MOTORS TOTALLY ENCLOSED AND STREAMCOOLED

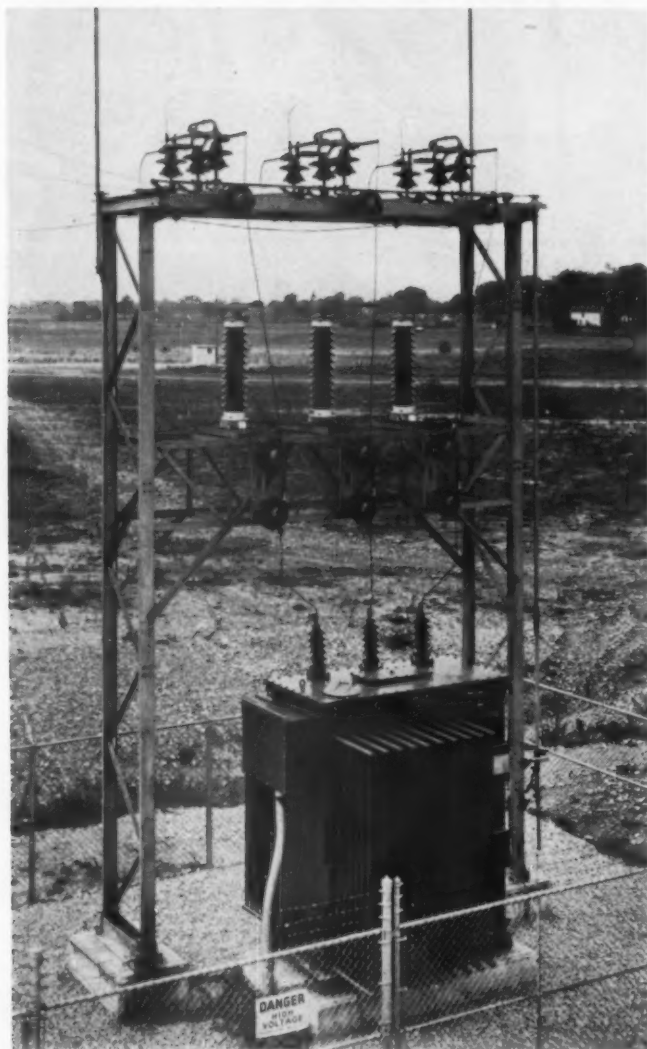
BALDOR ELECTRIC COMPANY

Baltric Motors Are Available in Polyphase • Squirrel Cage • Induction and Single Phase • Capacitor Start • Induction Run Types

4353 DUNCAN AVENUE • ST. LOUIS 10, MISSOURI

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . SEPTEMBER, 1955

for the new Sylvania Television Plant...



Three steps of power transformation in the new Sylvania Television Plant are supplied entirely by Uptegraff transformers. From the 2500 KVA power transformer shown at the left to the 120-volt lighting transformers shown on the page at the right, electric power is distributed by Uptegraff units.

Located in Batavia, New York, this is one of the world's largest and most modern television plants. Advanced engineering practices are employed throughout, to provide the ultimate in production facilities. The selection of Uptegraff transformers for this vital function of providing all the electricity for power and lighting is a tribute to the high quality and dependability of this equipment.

The power transformer is liquid-filled, rated at 2500 KVA, 34,400-4160 volts. The distribution transformers are dry-type air-cooled units, rated at 750, 300, 225 and 112½ KVA. In all, seven Uptegraff transformers are in service in this plant.

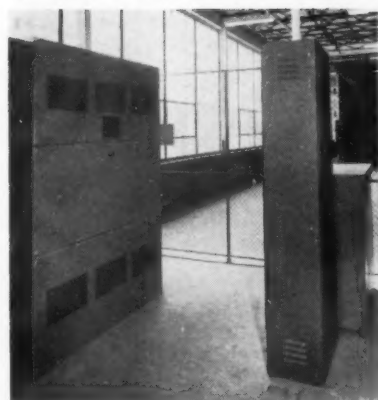
Uptegraff makes Power, Distribution, Instrument and Specialty transformers. Sizes are from 0.1 KVA to 10,000 KVA, 115 KV. Designed and built to meet or exceed all applicable NEMA, AIEE, ASA and other standards.

Electrical Contractor:
FERGUSON ELECTRIC CONSTRUCTION CO.,
Buffalo, N.Y.
Consulting Engineer:
J. FRUCHTBAUM, Buffalo, N.Y.
General Contractor:
JOHN W. COWPER CO., INC., Buffalo, N.Y.

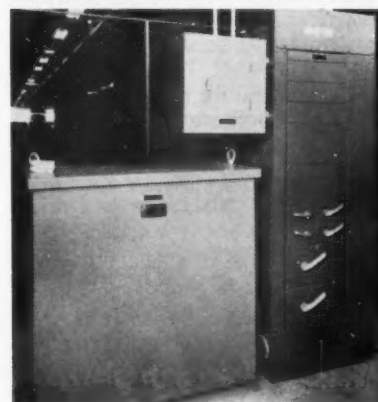
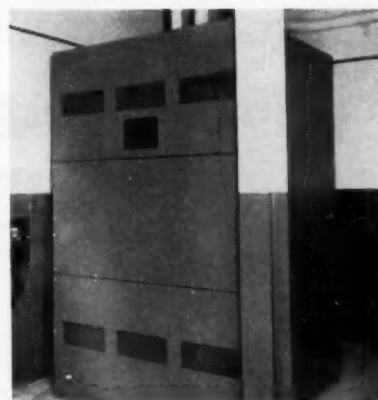




TRANSFORMERS throughout!

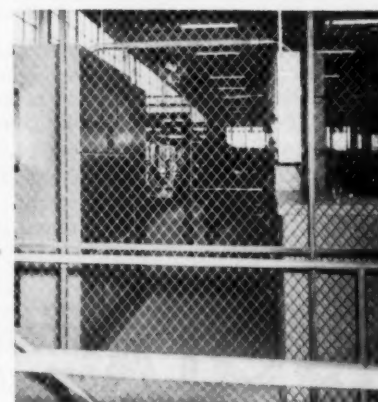


Shown here (left and right) are two of the four Uptegraff dry-type transformers used to provide both power and lighting current from the same distribution system, thus avoiding the duplication of units, common in the past. Two of the transformers are 750 KVA, and two are 300 KVA. All four are fed by 4160 volt circuits, and have 480Y/277 volt secondaries.

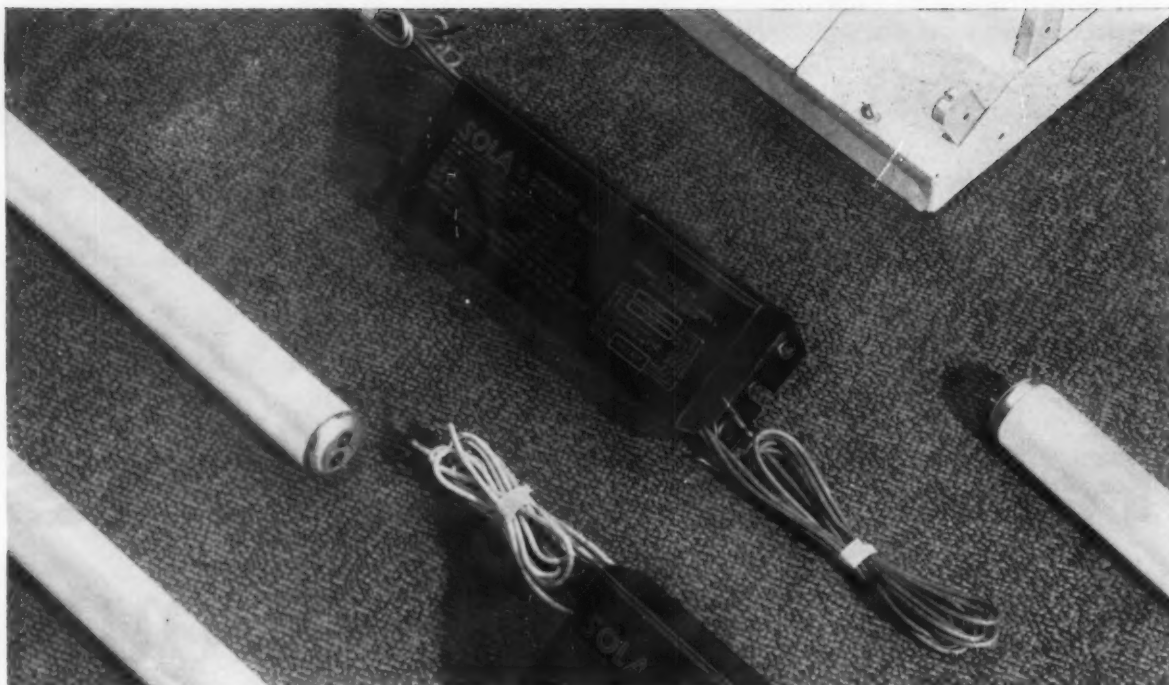


At the left is shown one of the Uptegraff dry-type transformers that provide 120-volt power. Two of these transformers are used, one being a 225 KVA unit, and the other 112½ KVA. Both have 480-volt primaries and 208Y/120 secondaries.

The photograph at the right shows how the dry-type Uptegraff transformers can be installed wherever desired, without vaults or other enclosures. This permits transformers to be safely located near the center of power usage, thus avoiding long costly runs of low-voltage circuits.



R. E. UPTGRAFF MANUFACTURING CO. SCOTSDALE, PENNSYLVANIA



PREMIUM PERFORMANCE FOR RAPID-START SYSTEMS: When Sola Constant Wattage Ballasts are part of your 40w rapid-start fluorescent lighting team, the result is longer lamp life, reli-

able starting, constant light output, quiet operation and long ballast life. The low, compact ballast for two 40w rapid-start lamps fits all standard fixture channels.

Sola Ballasts Provide Constant Wattage for 40-watt Rapid Start Systems at Ordinary Ballast Cost

Do you manufacture fixtures? Do you specify or install lighting equipment? If so, your 40w rapid-start fluorescent lighting system can now include the operating superiorities of Sola Constant Wattage Rapid-Start Ballasts — at the cost of ordinary ballasts.

1. LONGER LAMP LIFE: Lamp life is inversely proportional to the peak/rms ratio of the lamp's current wave shape. Sola Ballasts' peak/rms ratio is approximately 1.5 @ 118v — extremely low with good wave shape.

2. RELIABLE STARTING: The higher the voltage from lamp electrode to grounded fixture (an important starting aid) the more positive the starting. Sola 40w ballasts provide 300v across lamp-to-ground with perfect safety.

3. CONSTANT LIGHT OUTPUT: Lumen output held constant to within $\pm 2\%$ over a primary range of 106-130v — you get all the light you paid for regardless of 20% line voltage fluctuations.

4. QUIET OPERATION: Progressive compound pouring, special lamination design and pressed-in core-and-coil construction minimize lamination hum — ballasts are suitable for quiet-area installations.

5. LONG BALLAST LIFE: Temperature rise is low under normal operation. When one or both lamps fail or rectify, ballast operating temperature is reduced, not increased — result is low ballast maintenance cost.

Write for full information or request a Sola sales engineer to call with all the facts.

SOLA *Fluorescent*
BALLASTS



**REQUEST
BULLETIN
171-FL-199**

* CONSTANT VOLTAGE TRANSFORMERS for Regulation of Electronic and Electrical Equipment • LIGHTING TRANSFORMERS for All Types of Fluorescent and Mercury Vapor Lamps. • SOLA ELECTRIC CO., 4633 West 16th Street, Chicago 30, Illinois, Bishop 2-1414 • NEW YORK 35: 103 E. 125th St., Trafalgar 6-6464 • PHILADELPHIA: Commercial Trust Bldg., Rittenhouse 6-4988 • BOSTON: 272 Centre Street, Newton 58, Mass., Bigelow 4-3354 • CLEVELAND 15: 1836 Euclid Ave., Prospect 1-6400 • KANSAS CITY 2, MO.: 406 W. 34th St., Jefferson 4382 • LOS ANGELES 23: 3138 E. Olympic Blvd., ANgelus 9-9431 • TORONTO 9, ONTARIO: 617 Runnymede Rd., Lyndhurst 1654 • Representatives in Other Principal Cities



INTERCHANGEABLE PUSH-BUTTON CONTROLS



INTERCHANGEABLE . . . SO YOU CAN ASSEMBLE TO MEET ANY JOB REQUIREMENTS

You can assemble control stations that meet your job requirements *exactly*, because all A-H control units are completely interchangeable (within each of the 3 basic lines) and adaptable to local or remote control. A large number can be assembled in special, small-size, space-saving panel boards. Compactness that facilitates convenient positioning also simplifies installation and servicing.

STANDARD DUTY LINE . . . for use under all usual operating conditions up to 600 volts.

HEAVY DUTY LINE . . . has a greater contact capacity and is able to handle higher control currents and stand up under more rigorous operating conditions.

OIL TIGHT HEAVY DUTY LINE . . . is ideal to protect controls positioned on machine tools and other equipment where spraying or flooding with cutting oil or similar fluids is likely.

Mail coupon for your free folder "A-H Interchangeable Push Button Controls."

ARROW-HART

INDUSTRIAL CONTROL DIVISION

103 HAWTHORN ST., HARTFORD 6, CONN.

OFFICES, SALES ENGINEERS AND WAREHOUSES IN:

ATLANTA	DALLAS	MINNEAPOLIS	HAVANA, CUBA
BOSTON	DETROIT	NEW YORK	
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CINCINNATI	LOS ANGELES	ST. LOUIS	
CLEVELAND	MILWAUKEE	SAN FRANCISCO	LONDON, ENGLAND

Quality

MOTOR CONTROLS • WIRING DEVICES
ENCLOSED SWITCHES • APPLIANCE SWITCHES



INDUSTRIAL CONTROL DIVISION
THE ARROW-HART & HEGEMAN ELECTRIC CO.
103 HAWTHORN STREET, HARTFORD 6, CONN.

Please send my copy of "A-H Interchangeable Push Button Controls."

	NAME _____
	POSITION _____
	COMPANY _____
	CO. ADDRESS _____
	CITY _____ ZONE _____ STATE _____

Build customer good will

with



SORGEL dry-type transformers are recognized and accepted as high quality by engineers, contractors, and users everywhere.

You can establish and maintain the good will and confidence of your customers by supplying them with top quality, time-tested SORGEL transformers. Repeat business and increasing sales will be your reward.

When price competition presents itself, then remember that the first cost of dry-type transformers is not always the final total cost. The cost-saving features incorporated in SORGEL dry-type transformers are an assurance that their first cost is the final total cost. Furthermore, you'll never have complaints.

SORGEL dry-type transformers are preferred because of their cost-saving features and years of dependable service.

EASY INSTALLATION—Attached wall brackets.

EASY CONNECTING—Roomy connection compartment with solderless terminals.
Terminal boards above 5 KVA.

RUGGED CONSTRUCTION—All steel fabricated, for light weight and maximum strength.

LOW NOISE LEVEL—High efficiency.
Liberal design.

LONG LIFE—Thermo-vacuum impregnated windings brazed to terminals.

Complete Line

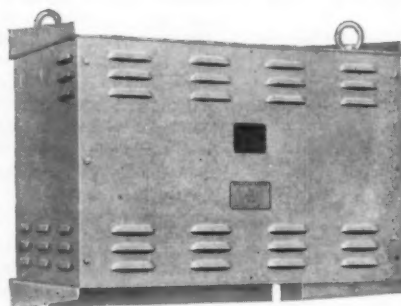
1/4 Kva to 2500 Kva, single phase.
1 Kva to 3000 Kva, 3-phase, 2-phase and phase changing.
All standard voltages, such as 120, 208, 240, 480, 600, 2400, 4160, 4800, 7200, 13,200, up to 15,000 volts, and any intermediate or special lower voltages.

Stock carried by jobbers in the following cities:

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Buffalo, N. Y.
Roxbury, Mass.
Philadelphia, Pa.
Cincinnati, Ohio
Cleveland, Ohio
Chicago, Ill.
Rock Island, Ill.
Rockford, Ill.
Richmond, Ind.
Louisville, Ky.
Cedar Rapids, Iowa
Davenport, Iowa
Omaha, Neb.
Beaumont, Texas
Los Angeles, Calif.



1/4 Kva
single phase
480/240 to
240/120 volts



15 to 50 Kva 3-phase. Wall mounting type



100 Kva single phase

Tested and approved by Underwriters' Laboratories under the Re-examination Service

Consult the classified section of your phone directory or write to factory

SORGEL ELECTRIC CO., 836 West National Avenue, Milwaukee 4, Wis.

40 years' experience in the development, manufacturing and application of transformers



*New plant
for a growing
newspaper...*



WIRE BY PHELPS DODGE

This outstanding newspaper plant—recently completed for Camden Newspapers, Inc., publishers of the Camden, N. J., Courier-Post—is New Jersey's newest and most modern.

Dependable Phelps Dodge wire and cable installed throughout the plant helps assure uninterrupted electrical service for the latest in newspaper equipment. This equipment includes an eight-unit,

four-color, high speed press printing up to 55,000 copies per hour and automatic machines to count, bundle and convey the papers to delivery trucks.

* * *

On every job, large or small, where top quality materials, expert workmanship and experienced "know-how" are called for, *it pays to rely on Phelps Dodge and your Phelps Dodge distributor!*



**PHELPS DODGE COPPER PRODUCTS
CORPORATION**

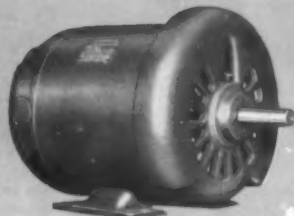
SALES OFFICES: Atlanta, Birmingham, Ala., Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Fort Wayne, Greensboro, N. C., Houston, Jacksonville, Kansas City, Mo., Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Roanoke, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

Examine the evidence...



FRACTIONAL HORSEPOWER MOTORS

Superior performance in a smaller "package"



**Totally Enclosed
Fan Cooled**

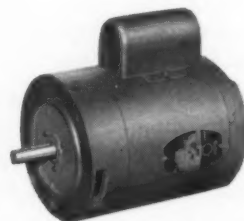
Century Fractional Horsepower Motors are quiet running, precision balanced and unusually free from vibration. They can be Performance-Rated to your specific needs in split-phase, capacitor and polyphase types with the following mechanical modifications:



**Open Type Drip Proof
with Cushion Base**



**Open Type Drip Proof
with Rigid Base**



**Can Be Furnished with
Bracket or Flange Mounting**

Century application engineers or authorized Century distributors are always at your service to help you fit a Performance-Rated motor to your job.

ROTOR

practically indestructible, high-pressure die-cast aluminum squirrel-cage rotor... assures uniform cross section of winding. Large capacity fans are cast integrally with the rotor winding for improved ventilation.

INSULATION

stator winding slots are insulated with laminated rag stock paper and costly "Mylar." "Formvar" plastic insulated wire is used for the coils. The complete stator winding is dehydrated and saturated with thermal setting baked plastic varnish.

LUBRICATION

the time-tested wool yarn method of cleaning and circulating the oil... large capacity reservoir.

BEARINGS

same reliable sleeve design that has been tested and perfected by Century for over 50 years... machined from shell molded Phosphor bronze castings... ball-bearing motors also available.

GOVERNOR

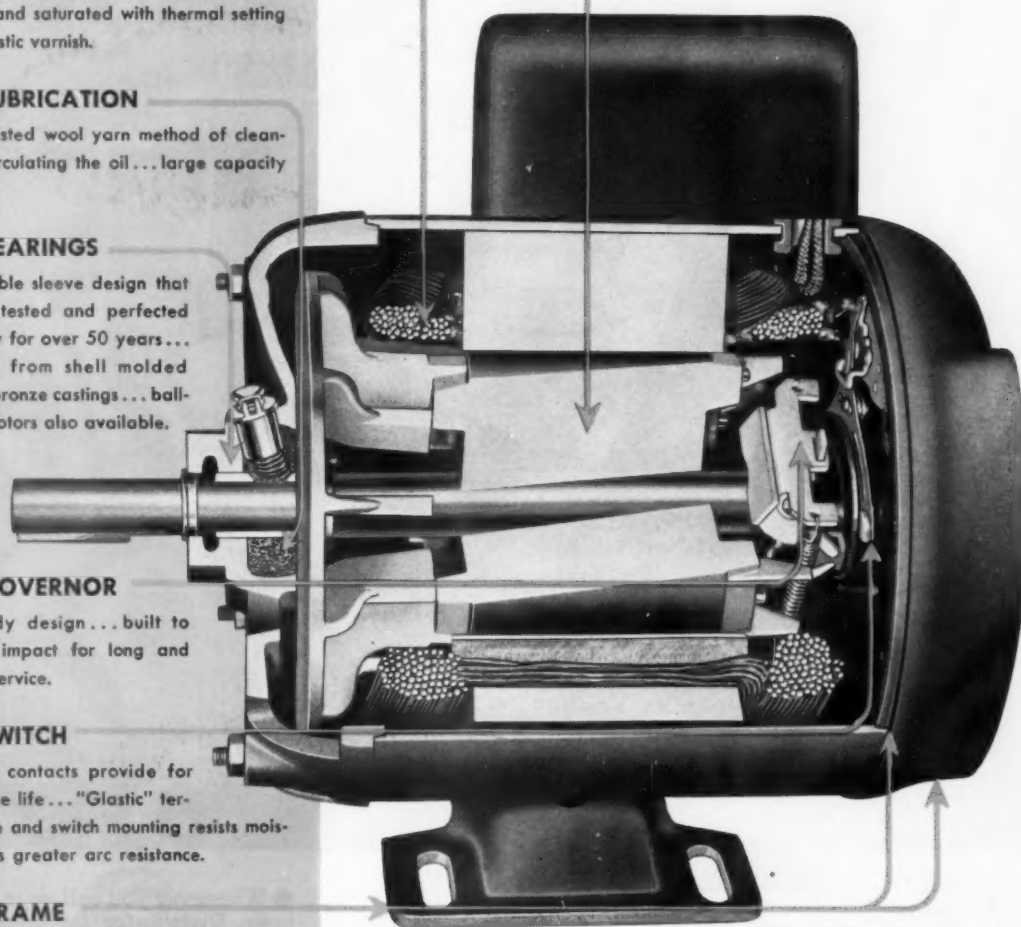
new, sturdy design... built to withstand impact for long and accurate service.

SWITCH

coin-silver contacts provide for long service life... "Glastic" terminal base and switch mounting resists moisture... has greater arc resistance.

FRAME

heavy gauge steel, accurately machined for close-tolerance fit with the cast iron, drip proof end bracket. Base is welded to the frame and the bottom is milled for solid mounting and accurate centering.



CE-22

Performance-Rated[®] MOTORS
1/8 to 400 H. P.



CENTURY ELECTRIC COMPANY

1806 Pine Street, St. Louis 3, Missouri • Offices and Stock Points in Principal Cities

Ready and tagged for YOU!

WHY YOUNGSTOWN BUCKEYE CONDUIT IS BETTER

Youngstown is the one manufacturer who makes rigid steel conduit from ore to finished product. This enables Youngstown to control the complete manufacturing process—your insurance that each length of "Buckeye" is made of top-grade steel.

Call your Youngstown Distributor.

Youngstown

BUCKEYE



CONDUIT

● Whenever you call your Youngstown Distributor for Youngstown Buckeye rigid steel conduit, your order is made ready and tagged for fast delivery to you. Service is quick and sure—an important factor in helping you keep your jobs on schedule. Save time and trouble—call your Youngstown Distributor next time you need good steel conduit.

THE YOUNGSTOWN SHEET AND TUBE COMPANY

*Manufacturers of
Carbon, Alloy and Incoloy Steel*

General Offices: Youngstown, Ohio - District Sales Offices in Principal Cities
SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT
AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - BAR SHAPES - WIRE -
HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - RAILROAD TRACK SPIKES



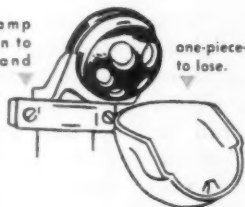
new "swing top" entrance cap with the hood that hangs on a hinge!

longer radius for easier
wire handling—less wire
insulation-strain.



greater hood overhang
for maximum protec-
tion from elements.

quick clamp
connection to
conduit and
EMT.



PATENT PENDING

FOR EASIER, COST-SAVING INSTALLATION

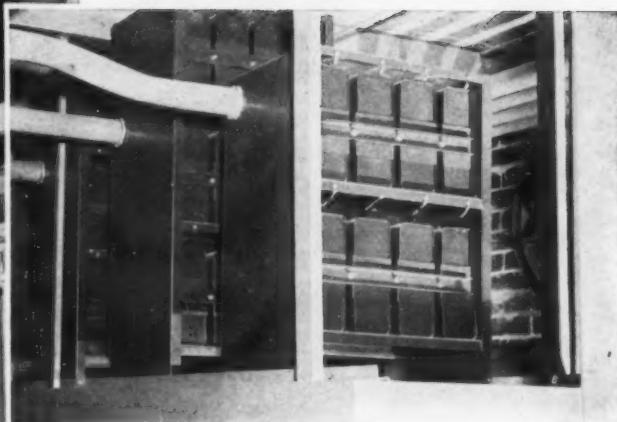
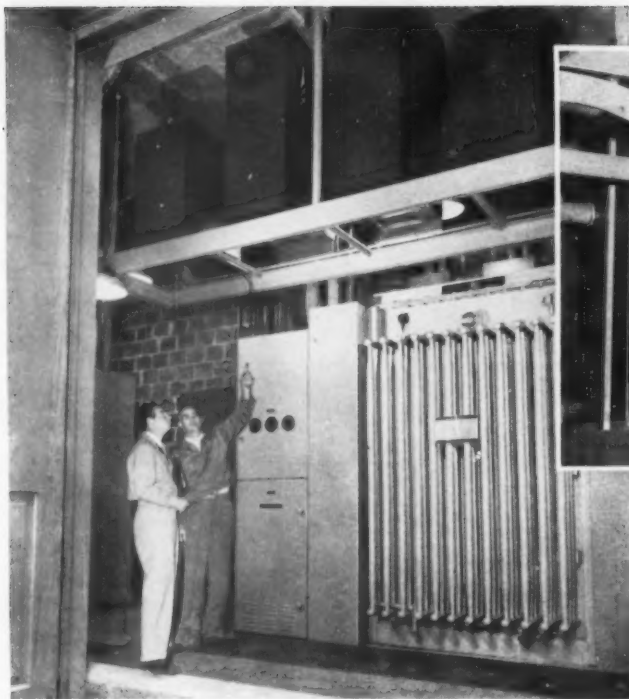
• Cut entrance installation time by *two-thirds* with Efcor's new "Swing Top" entrance cap. Loosen one screw, swing the hood open . . . that's all it takes to pull wires through the head! The patented, one-piece hinged construction retains the hood until you're ready to replace it. With conventional units, you're required to loosen several screws, completely remove the cover, put it in your pocket, or on the ladder where it might fall to the ground. "Swing Top" also has a longer radius to facilitate wire pulling and minimize strain on wire insulation. The rugged clamp connector permits quick attachment to conduit *directly against the wall*. No threading, no offsetting needed . . . accommodates EMT too.

WRITE FOR FREE SAMPLE or see your *Electrical Distributor*.



electrical fittings corporation

37-50 57th STREET • WOODSIDE 77, NEW YORK



G-E 300-kvar capacitor rack is located out of the way in another part of the recovery room substation.

R. C. Sherrill, Plant Electrician, right, and J. J. McCarthy, G-E Sales Engineer, discuss the G-E capacitor installation in the recovery room substation.

G-E CAPACITORS HELP BOOST PLANT GENERATOR AND SUBSTATION CAPACITY

Riegel Carolina Corporation carries additional load with help of capacitors

"Power factor has jumped from 82 to 95 per cent, and we've released 1100-kw capacity to our plant," reports R. C. Sherrill, Plant Electrician for the Riegel Carolina Corporation, Acme, N. C. "As a result, we've released capacity on eleven substations, enabling us to install more bleaching stages in the plant," said Mr. Sherrill.

Here is how G-E capacitors helped this company: With mill load peaked, only 1700-kw capacity was available in the present facilities. However, due to various expansion projects mill load was expected to increase by 2800 kw. More substation capacity was needed immediately and shortly the mill's power supply would have to be expanded. With the installation of 3240 kvar of capacitors, substation load-

ing was reduced and 1100 kw of turbine generator capacity was made available.

G-E CAPACITORS CAN SAVE YOU MONEY, TOO!

Whether you buy or generate your own power, low power factor costs you money. General Electric capacitors improve power factor and cut power costs. Also, G-E capacitors can economically supply a needed boost when voltage is a problem. Besides this, G-E capacitors can often increase system capacity without requiring expensive rewiring or additional generating equipment. Find out how you can start saving with G-E capacitors by contacting your nearest G-E Apparatus Sales Office, or write for Bulletin GEA-5632, General Electric Company, Section 441-110, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL  ELECTRIC



**POWER
DISTRIBUTION**

SAVINGS

SYSTEM

PRODUCTS

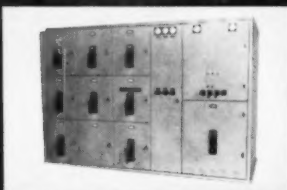
Save up to 25% with G-E equipped power distribution systems for commercial buildings

**YOU BENEFIT THREE WAYS FROM G-E
EQUIPPED 480Y/277-VOLT DISTRIBUTION:**

1. First-cost savings
2. Expansible, efficient system
3. Single equipment source

This system can help designers, owners, builders save 10 to 25 per cent on initial costs. Higher-voltage distribution provides an effective answer to today's heavy electrical loads. Its flexibility and economy allow realistic anticipation of the even larger loads of tomorrow.

GREATEST SAVINGS FROM . . .



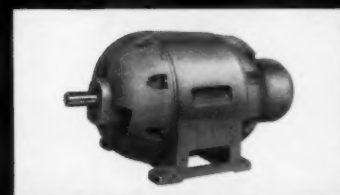
PROTECTIVE DEVICES



RISERS AND FEEDERS



INSTALLATION



LARGE MOTORS AND CONTROL

Progress Is Our Most Important Product

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FOR GUIDE TO
YOUR OWN
SAVINGS
MAIL COUPON
ON LAST PAGE
OF THIS AD



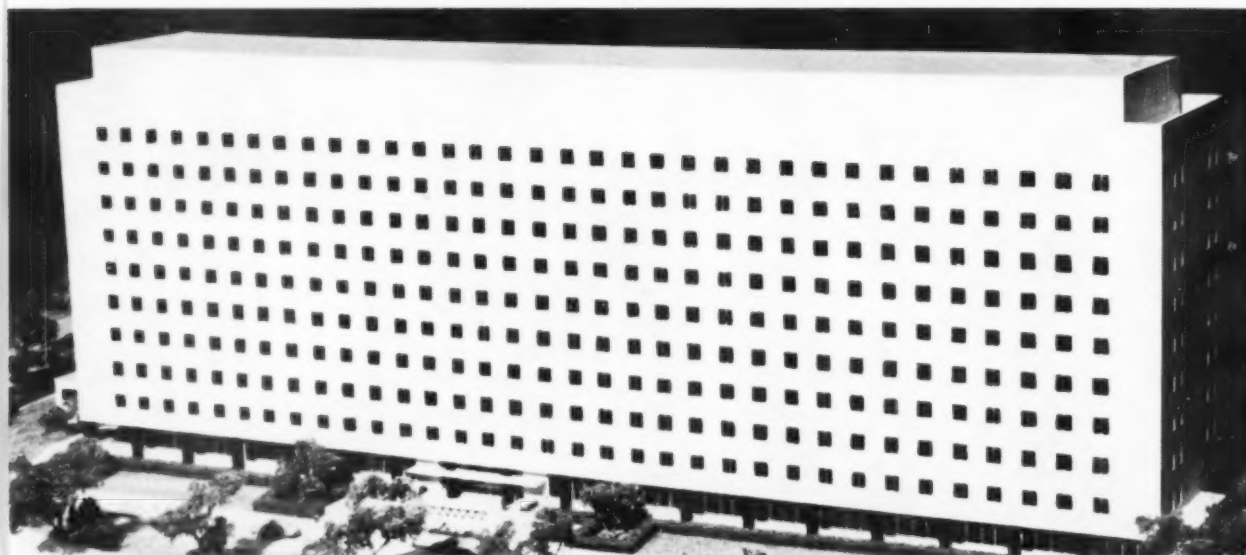
\$1,500,000 SAVINGS on equipment were obtained when system was selected for New York Coliseum. Combining 365,000 square feet of display space with 26-story building presented unique

opportunities for savings with higher-voltage system. Leon and Lionel Levy, architect; Guy B. Panero Engineers, consulting engineers; Walsh-Fuller-Slatery, general contractors; Jackson-Livingston, electrical contractors.



\$12,000 SAVINGS resulted at Twin Falls, Idaho high school with 480Y/277-v system even though 120-v load was large percentage of

total. One of the earliest applications of new system, school is ideal example of savings possible in small horizontal buildings. Entire load for school totals only 600 kva.



\$20,000 SAVINGS were obtained with 277-v lighting in Pennsylvania's new office building for the Dept. of Property & Supplies, Harrisburg, a Gen. State

Authority project. Here system proves value in longer, lower building. Lacy, Atherton and Davis, architects and engineers; The Howard P. Foley Co., electrical contractors.



**POWER
DISTRIBUTION**

SAVINGS

SYSTEM

PRODUCTS

Higher-voltage systems can pay off for you as they did in these four buildings

Average electrical loads in commercial-type buildings have grown to equal many in industrial plants (approximately 10 volt-amperes per sq. ft.). With increased use of air conditioning, electronic equipment, appliances, and better lighting, loads will continue to grow.

ARCHITECTS, CONSULTING ENGINEERS, contractors, and building owners must provide first-class power distribution systems to meet today's demands and anticipate tomorrow's needs—yet keep costs within reason.

ONE SOLUTION IS TO SELECT 480Y/277-volt power systems when remodeling old or constructing new buildings. The success of the system in the four buildings illustrated is dramatically indicated by the large savings made in each case.

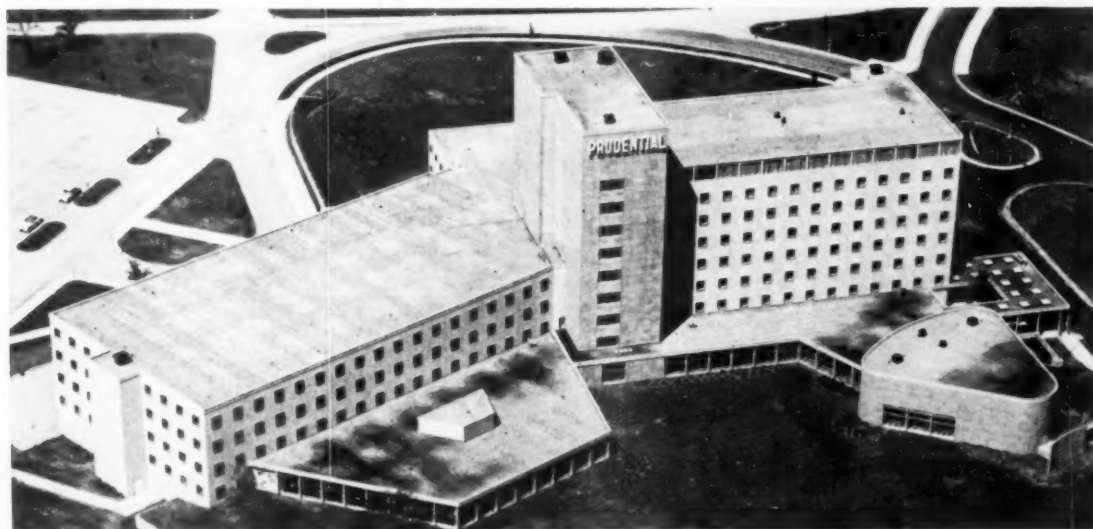
Comparable savings with this system exist when 33 to 50% of building load can be served direct from system voltage and when feeders average 200 feet in length. For detailed cost and savings information, use coupon on last page of this ad.

SEE HOW THIS SYSTEM WORKS ►

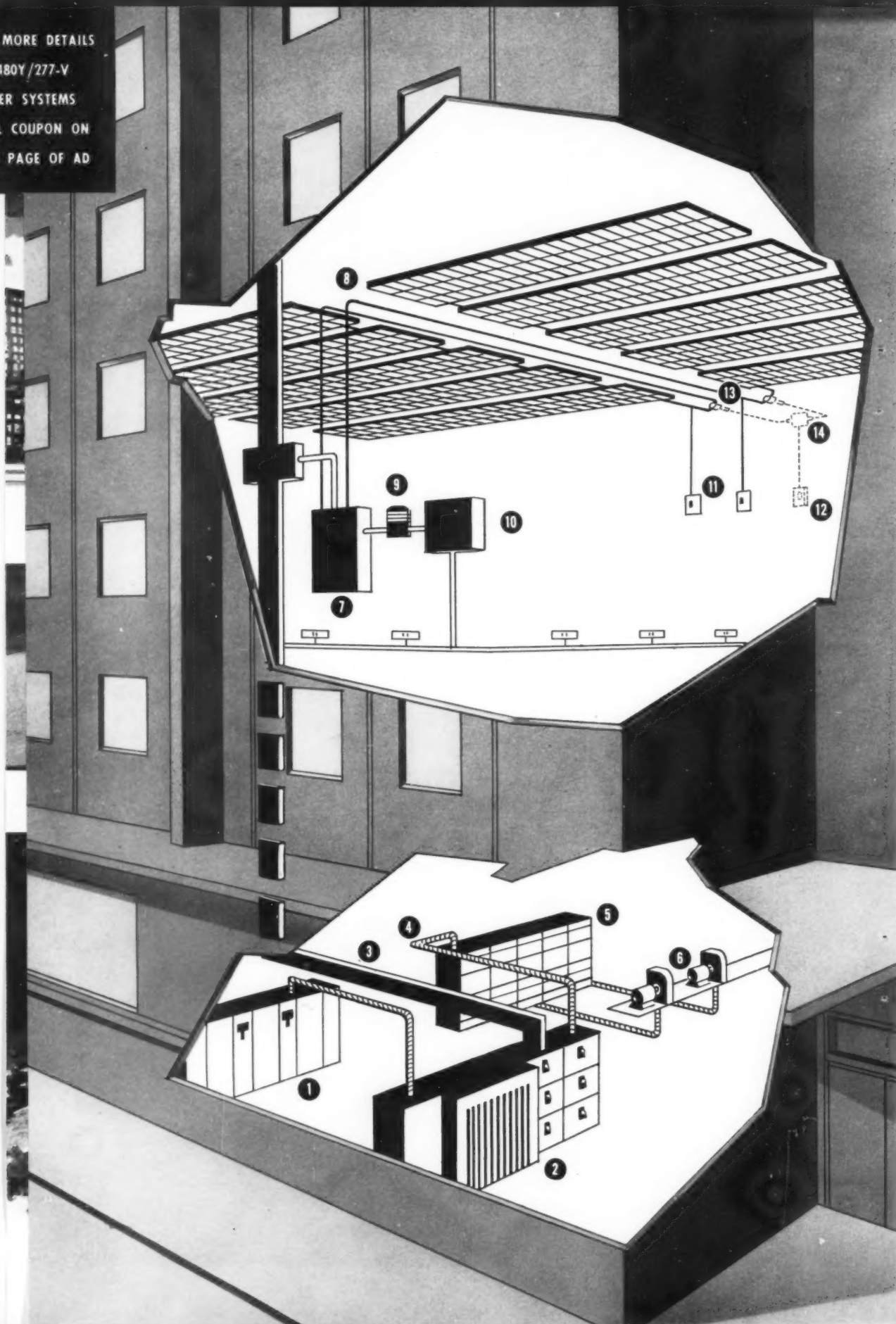
GENERAL  ELECTRIC

\$50,000 SAVINGS was the approximate, calculated dollar advantage that resulted from using the new system at the Prudential Insurance Co. North Central home office building, Minneapolis.

Rambling wings and 10-story tower makes system ideal for this structure. Magney Tusler & Setter, architects and engineers; C. F. Haglin & Sons, general contractors; Electric Repair & Construction Co. electrical contractors.



FOR MORE DETAILS
ON 480Y/277-V
POWER SYSTEMS
MAIL COUPON ON
LAST PAGE OF AD





**POWER
DISTRIBUTION**

**SYSTEM
PRODUCTS**

G-E higher-voltage systems provide flexibility to meet future demand, use lower-rated equipment to supply larger loads

Because volumetric and floor space in commercial-type buildings is so valuable, substations usually must be located in basements and penthouses. This can mean long runs for secondary feeders. The greatest savings with higher-voltage distribution come from *halving* either the number and/or size of these feeders and their branch circuits.

SAVINGS AS HIGH AS \$30 PER KVA of demand can be obtained. Conductors carry two to four times the power they could at 120/208Y volts—meaning fewer and smaller circuits and great savings in copper throughout system. In addition, lower-rated and fewer circuit breakers are needed since lower-current distribution at higher voltage allows each breaker to serve more kva load. Motors above 500 hp cost less at 480 volts. Motor control at the higher voltage costs less for any motors. Higher-voltage distribution also

cuts feeder voltage drop, watt losses. Because less equipment and smaller equipment is needed, installation is easier, less expensive. Much valuable space is saved.

When time comes to expand capacity, original savings and advantages are repeated. More new equipment can be installed in space that would have been used initially with a 120/208Y-volt system. When modernizing old buildings it is often possible to *retain original conductors* and conduits, switch to higher voltage and increase capacity.

120-VOLT POWER IS PROVIDED by small low-cost transformers. Greatest savings occur when 277-volt lighting is used, *but* studies show big savings may still exist even if *all* lighting operates at 120 volts from small transformers. For full information on this economical, flexible system, send coupon on last page of this ad.

SEE STANDARD EQUIPMENT FOR USE IN THIS SYSTEM ►

GENERAL  ELECTRIC

HERE'S HOW 480Y/277-V SYSTEM FITS A TYPICAL BUILDING

Cutaway shows components of higher-voltage system for building supplied with primary power by the utility.

Incoming power is brought through metal-clad switchgear (1) and distributed to unit substations (2) which step voltage down to required 480Y/277 volts. Busway or cable risers (3) carry power up to each floor while feeders (4) distribute it to motor control centers (5) for the air-conditioning, elevator and ventilating-fan motors (6).

On each floor power runs from risers to panelboards (7) supplying 277 volts for lighting (8). Circuit also runs from this panelboard to

small dry-type transformers (9) which furnishes power through a second panelboard (10) to the 120-volt floor circuits.

Lighting power may be safely controlled by conventional wall switches rated 20 amps, 277 volts (11) or by 24-volt remote-control switches (12). If remote control is used, relays (13) are required to accomplish switching and small transformers (14) to supply 24-volt power to remote-control switch for activating relays.

If secondary power (utilization voltage) is supplied by the utility, system begins at low-voltage switchgear section of substation.

FOR MORE DETAILS
ON G-E EQUIPMENT
FOR POWER SYSTEMS
MAIL COUPON
ON LAST PAGE
OF AD



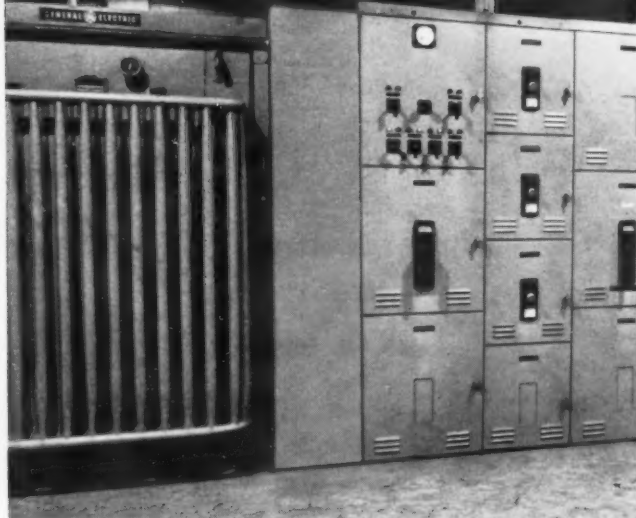
RELIABLY GUARDING system at entrance, G-E metal-clad switchgear is factory preassembled to save installation time. G-E magne-blast breakers are safer and easier to maintain.



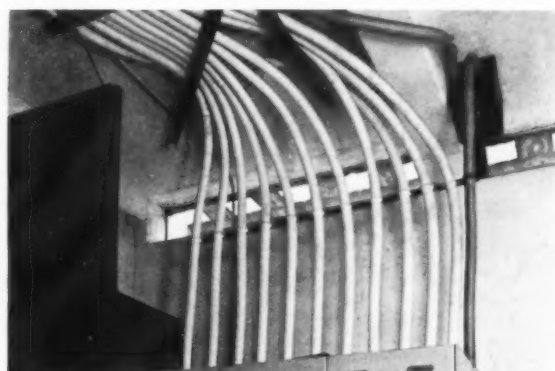
COMPACT G-E motor control centers place all control in easy reach and view of operator. Ready-to-install units are fully accessible to make connecting and servicing easier.



SAFER, SURER PROTECTION and control of 277-v circuits result with General Electric panelboards. Designed to take less space, they provide ample room for easy wiring.



KEYSTONE OF SYSTEM, General Electric unit substations dependably furnish power, close to load as possible, on well-protected circuits. They arrive at the site in integral units ready



FASTER, LOWER-COST INSTALLATION is possible with risers and feeders of G-E interlocked armor cable. Simple to install, it bends easily around obstructions, and needs no conduit.



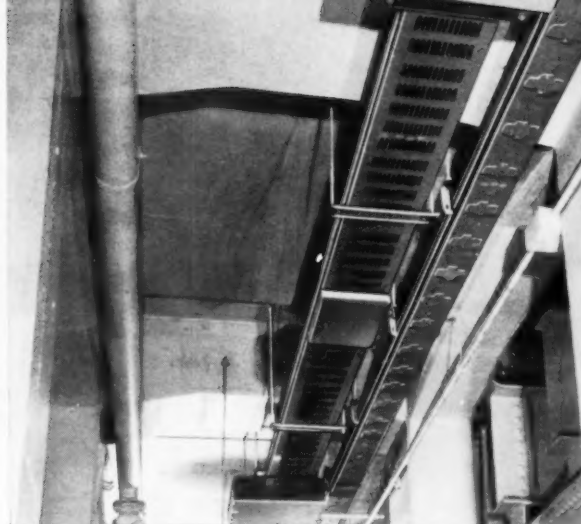
LOW-COST SOURCES OF 120-v power, G-E dry-type transformers feature simple installation, quieter operation. They can be mounted almost anywhere, require little attention.



QUICK, EASY WIRING of G-E 120-volt panelboards is facilitated by roomy wiring gutters, all solderless connections. The 120-volt circuits serve portable machines and appliances.



for quick installation. Compact and flexible, they fit into system wherever space is available, serve as "building blocks" for expansion.



LOW-VOLTAGE-DROP distribution is provided by risers and feeders of G-E Flex-A-Power* busway. It assures most efficient service on long runs. Prefabricated sections and fittings provide easy, flexible installation.

*Reg. trade-mark G.E. Co.



**POWER
DISTRIBUTION**

PRODUCTS

Standard G-E products, available from single source, ease system planning, application, purchasing

General Electric offers all the needed electric equipment for any power distribution system. Packaged purchasing of all distribution equipment from one supplier assures smoother integration and performance of system. Design, accounting, and clerical work is saved by the convenience and efficiency of dealing with only one central source of equipment.

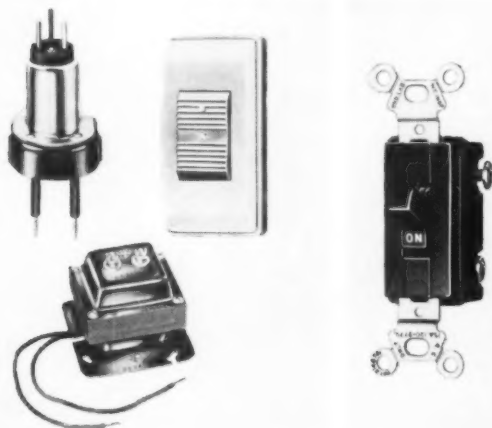
G.E. CO-ORDINATES EQUIPMENT DELIVERY with your construction schedules—no waiting for needed items nor storing of those shipped too early. Installation is speedier because factory assembling of

major equipment groups saves valuable time at site.

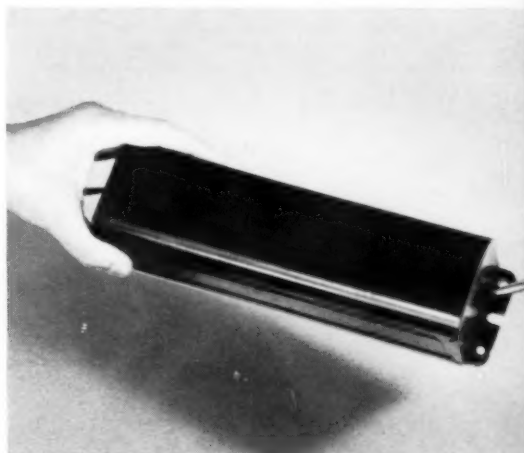
Uniform G-E equipment fits easily together into a highly dependable, attractive system because units are naturally designed to look better, work better together. Mail coupon on last page of this ad for more details on packaged vs. piecemeal systems.

**SEE ENGINEERING SERVICES AVAILABLE
TO YOU WITH G-E EQUIPMENT** ►

GENERAL  ELECTRIC



APPROVED SWITCHES for 277-v lighting include new conventional snap switch (r) or remote-control switch (l), which uses small transformer to supply 24-v power to relay operating coils.



AVAILABLE AT NO EXTRA COST in larger lots of popular ratings, 265-v lamp ballasts serve lighting with longer, quieter operation, common to all G-E ballasts.

G-E ENGINEERING SERVICES . . .

HELP PROTECT YOUR EQUIPMENT INVESTMENT



FROM PLANNING TO COMPLETION of building, General Electric engineers like Don Beeman (left) and Howard Kurt (right), both pioneers in development of 480Y/-277-v systems, help you select and apply the right equipment for efficient operation.

1. APPLICATION ENGINEERING helps architects and consulting engineers select and design the right electric system.

2. ANALYTICAL ENGINEERING helps design the optimum electrical system. Engineering experience, backed-up by electronic system analyzers save valuable design time.

3. PRODUCT DEVELOPMENT laboratories design and test new equipment under tomorrow's conditions to meet future demands.

4. FIELD-SERVICE ENGINEERING helps supervise installation, expedite start-up of major electric equipment.

5. MAINTENANCE SERVICE from 32 G-E Service Shops will repair and uprate old equipment, help establish productive maintenance of equipment, furnish emergency service.

6. PROJECT CO-ORDINATION means on-time engineering, shipment, installation of electric equipment from preliminary planning through start-up.

G-E SERVICE CAN WORK FOR YOU when you specify "G.E." equipment. Your G-E Apparatus Sales Representative can obtain any or all of the above services for you—contact him. For full story of the service available with G-E power distribution equipment, mail coupon below. General Electric Co., Section 680-1, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

MAIL TODAY for more information on modern power distribution systems



GENERAL ELECTRIC CO.
SECTION 680-1, SCHENECTADY 5, N. Y.

Please send me:







- ☐ your basic brochure, "Modern Power Distribution Planning Guide" (GEA-6344).
☐ I am especially interested in power distribution for buildings within secondary network areas, so include "Modern Distribution Equipment for Commercial Buildings in Secondary Network Areas" (GEA-6223).

NAME _____

POSITION _____ COMPANY _____

ADDRESS _____

CITY _____ STATE _____

IF THIS IS YOUR APPLICATION ...	AND YOUR AVERAGE NOISE LEVEL IS HERE ...				WE RECOMMEND		
					SOUND RATINGS		
 Broadcast Studio Church Country Residence					A	B	C
 Evening School City Residence Quiet Office					B	C	D
 Average Residence Public Library Study Hall					C	D	E
 Classroom Professional Office		37-42 decibels			D	E	F
 Noisy Residence Business Office		43-48 decibels			E	F	F
 Store Noisy Office Factories		49 decibels and			F	F	F

FLORA SHOWS YOU how easy it is to select a G-E ballast to meet your noise level requirements. For example: in a library installation

where noise levels must be extremely low, or in a quiet office where ballast noise could interfere with work, G.E. has a ballast to do the job.

Flora* shows you why ...

General Electric Sound-rated Ballasts Help You Save Lighting Dollars

Fluorescent lighting today is used in a countless variety of applications; from ultra-quiet broadcast studios and library reading rooms to noisy factories and offices. To help you select a lamp-ballast combination to meet the sound requirements of your installation, General Electric conducts extensive tests to measure the average sound level of each ballast model. This

measurement is called "Sound Rating."

This exclusive G-E feature enables you to specify a model sound-rated to meet the needs of your fluorescent installation. You save valuable lighting dollars by reducing expensive noise complaints.

Next time you specify equipment for a fluorescent lighting installation, make sure you get the best ... specify Gen-

eral Electric sound-rated ballasts. Look for the sound rating on the nameplate. A G-E ballast tag or sticker on your fixture is proof that it's equipped with the best in ballasts. It's the easy way to be certain. For further information on G-E ballasts, write Section 401-8, General Electric Company, Schenectady 5, New York.

*Miss Fluorescent Ballast, G.E.'s Ballast Mascot.
Copyright 1955, General Electric Company.



G-E BALLASTS operate more quietly than average ballasts, and G-E engineers are constantly testing new materials and methods in order to better control ballast noise.

Five more reasons why

GENERAL ELECTRIC IS YOUR BEST BALLAST VALUE

- SUPERIOR QUALITY CONTROL
- LONGER BALLAST LIFE
- PRECISE LAMP-MATCHED DESIGN
- PROVED PRODUCT LEADERSHIP
- COMPLETE CUSTOMER SERVICES



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DRY-TYPE TRANSFORMERS



1 **MERCURY LAMP** transformers can be specified for pendant or wall mounting. Roomy junction box behind nameplate makes wiring easy; six-inch leads speed installation.

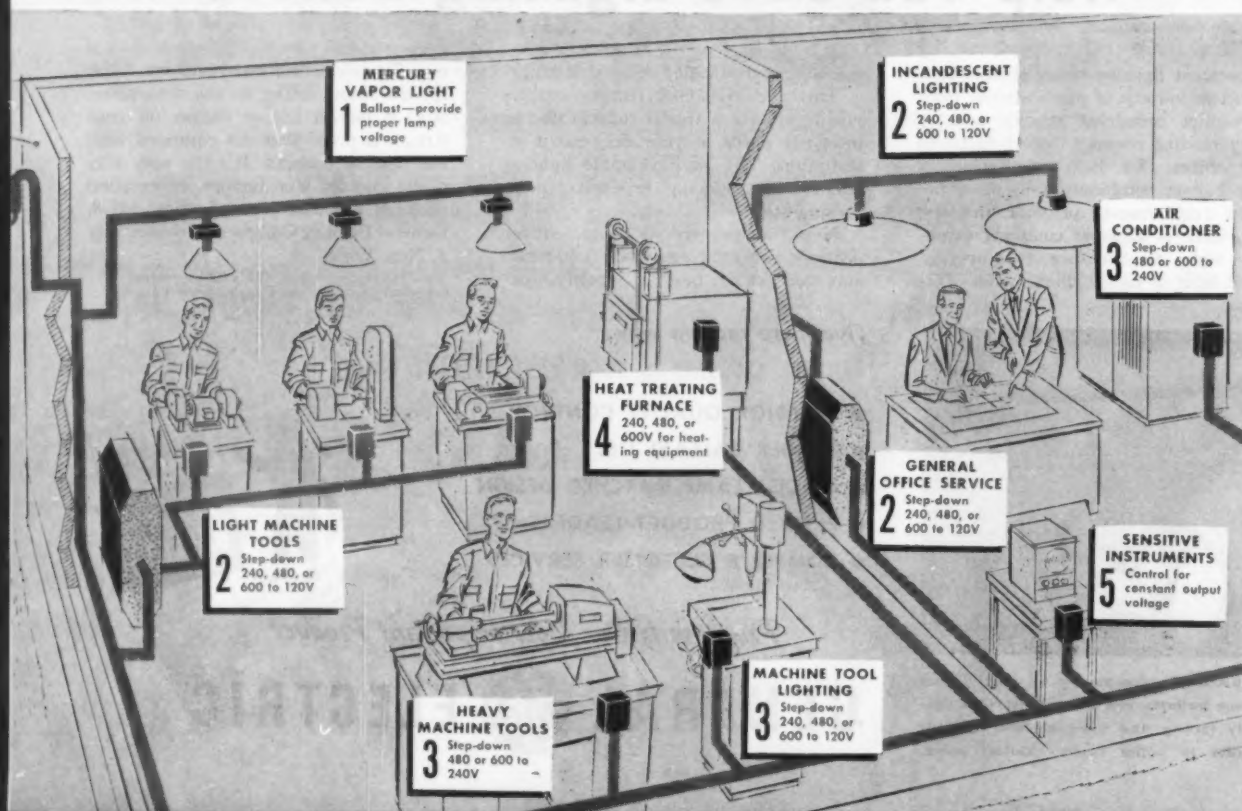


2 **TYPE D** transformers, for indoor service only, are ideal for general-purpose light and small power service. Available in ratings 25 kva and above.

Here's how five standard General assure you the proper operating

THESE APPLICATIONS of General Electric dry-type transformers are typical of small plant and office installations served at 240, 480, or

600 volts and not requiring load centers. The numbers on the dry-type transformers in this illustration refer to equipment described above.





3 TYPE M transformers for indoor or outdoor operation are also ideally suited for general-purpose light and power service. Available in all ratings through 15 kva.



4 SATURABLE REACTORS provide a very efficient method of controlling voltages to heating equipment and other variable load devices. Available in ratings 3-300 kva.



5 VOLTAGE STABILIZERS provide a dependable source of constant output voltage. Available in ratings 0.15 to 5 kva.

Electric dry-type transformers can voltage you want, where you want it

Dry-types in stock now will meet 90% of your requirements for precise voltage at the right place

G-E dry-type transformers, voltage stabilizers and saturable reactors, can be installed quickly . . . *at the load*. Standard models, ready for delivery, will meet most requirements. And you'll like the attractive price of G-E units!

The illustration at left demonstrates a few applications of G-E dry-types that are common in building modernization, expansion, and new construction where service is at 240, 480, or 600 volts.

Most electrical equipment for industrial or commercial use is not built to operate at distribution voltages. With dependable G-E dry-type transformers, you can obtain peak utilization of this equipment. G-E dry-types conserve

power and copper feeders, and give accurate control because they can be installed at the load.

Standard units will fill your needs in most cases. In those instances where you need a special unit, we can modify a standard transformer, or build a custom-designed unit for you.

When you need assistance in voltage transformation or control, call your nearest G-E Distributor or Apparatus Sales Office. Or if you want prices and specifications on the standard units described above, complete the coupon and we'll promptly send the information. General Electric Company, Schenectady 5, New York.

**MAKE GENERAL ELECTRIC
YOUR SOURCE OF SUPPLY FOR
ALL DRY-TYPE TRANSFORMERS**

**General Electric Company
Section F 410-8
Schenectady 5, New York**

Please send me the following bulletins:

- ☐ LS-103 Mercury Lamp transformers
- ☐ GED-2024 M&D transformers
- ☐ GEC-976
- ☐ GEC-1208
- ☐ GEC-1207 Distribution transformers
- ☐ GEC-1296 Saturable reactors
- ☐ GEA-5754 Voltage stabilizers

Lighting transformers

Name.....

Company.....

Address.....

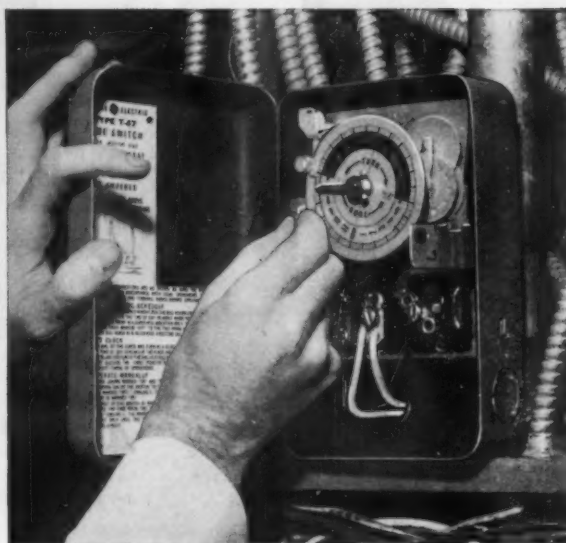
City..... State.....

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MODERATE PRICE: For only \$11.50* G.E.'s T-47 Time Switch provides reliable on-off control for many electrical operations; eliminates manual push-button "start-and-stops."



ACCURATE ON-OFF SETTING: Minimum on-time setting, 5 min.; maximum on-time setting, 22 hrs. for 1 or 2 on-off operations daily. Only the T-47 offers such close time setting.

Low-Cost, Dependable On-Off Control With General Electric Time Switches



PRECISION TIMEKEEPING: Once set, a long life of dependable control on a predetermined schedule is assured in this time switch by the synchronous, self-starting, Telechron† motor.

In addition to offering inexpensive, positive on-off control, the General Electric T-47 time switch has two additional advantages:

FAST INSTALLATION—Easily removable snap-cover, plainly marked terminals at switch front, roomy hand space and five double knockouts facilitate installation.

IMMEDIATE EXCHANGE PLAN—If the T-47 becomes inoperative within 18 months after date of manufacture, you receive *immediate*, over-the-counter replacement at no extra charge.

FOR MORE INFORMATION on T-47, contact your nearest authorized General Electric time switch distributor. Ask for G-E time switches at his store by name and write for Bulletins GEA-5965 and GEC-578B to Section 603-169, General Electric Company, Schenectady 5, New York.

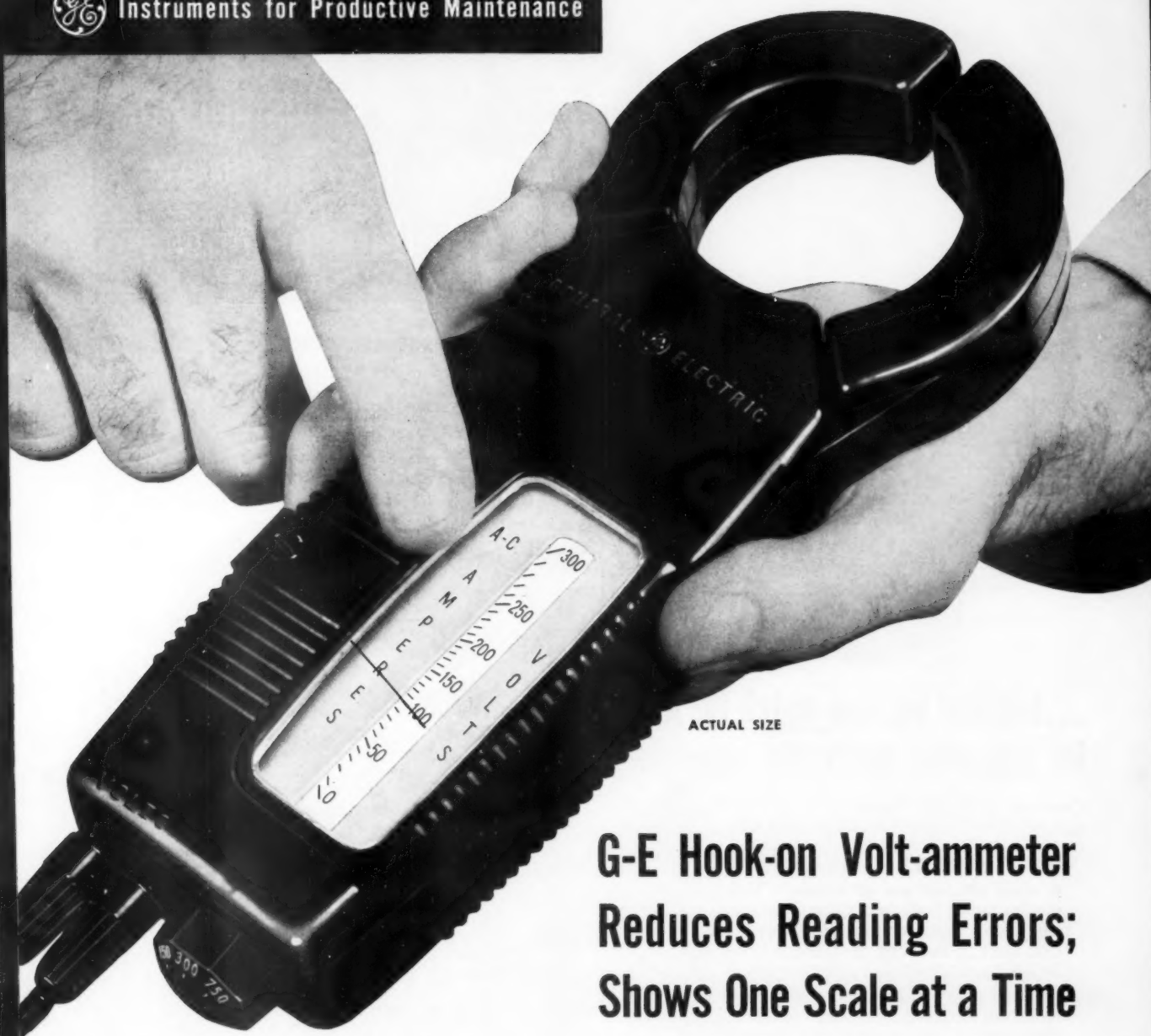
*Mfr's suggested retail price.

†Reg. Trademark of General Electric Co.

GENERAL  **ELECTRIC**



Instruments for Productive Maintenance



ACTUAL SIZE

G-E Hook-on Volt-ammeter Reduces Reading Errors; Shows One Scale at a Time

GENERAL ELECTRIC'S hook-on volt-ammeter shows only one scale at a time. You simply select the desired range and only the corresponding scale is visible. This eliminates the possibility of reading the wrong scale, as can be done with multiple scale face instruments. The range and scale of this G-E instrument are changed simultaneously by turning the finger-tip control knob. The two models of the instrument are designated Types AK-4 and AK-5, and both have current scales marked in black and voltage scales marked in red.

USED BY contractors, electricians, engineers, maintenance and servicemen, the G-E hook-on is ideal for

balancing circuits and tracing faults and grounds without shutting down equipment.

WIDE RANGES are available in both models of the G-E volt-ammeter. Ranges of the AK-4 model are 0-10/30/-100/300/800 amperes and 0-150/300/750 volts. The AK-5 ranges are 0-5/20/80/350 amperes and 0-150/-300/750 volts. The wider range AK-4 model has a pointer-stop to check surge readings.

FOR FURTHER INFORMATION, write section 582-10, General Electric Co., Schenectady 5, New York and ask for bulletin GEA-6292, or contact your nearest G-E Apparatus Sales Office.

Progress Is Our Most Important Product

GENERAL  **ELECTRIC**



**Before Silicone Insulation,
"over-motoring" was
standard practice!**

...but now you can match the load; let silicones carry the overload!

Overload capacity ranges up to 50% for Class H compared with 15% for comparable Class A motors.

that means

- **more efficient use of motors.** You can use the service factor built into silicone insulated motors to carry most initial or intermittent overloads or loads that can't be matched in standard frame sizes.
- **smaller motors** that require less magnetizing current and give you better power factor than ordinary motors of the same hp rating, because silicone insulation permits higher operating temperatures.
- **more continuous production.** Motor failure . . . down time . . . repair and replacement costs are reduced by built-in overload capacity and superior resistance to corrosive or abrasive atmospheres, high ambient temperatures and moisture.

Remember over-motoring is outmoded

Dow Corning Corporation, Dept. 3909, Midland, Mich.

Please send me sources of supply for new Silicone (Class H) ☐ Motors ☐ Transformers

☐ Information about Allis-Chalmers motors with Silco-Flex

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

**DOW CORNING
SILICONES**

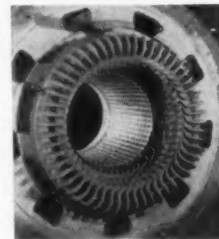
**DOW CORNING CORPORATION
MIDLAND, MICHIGAN**

ATLANTA • CHICAGO • CLEVELAND • DALLAS • DETROIT
LOS ANGELES • NEW YORK • WASHINGTON, D.C. (Silver Spring, Md.)

CANADA: Dow Corning Silicones Ltd., Toronto

GREAT BRITAIN: Midland Silicones Ltd., London

FRANCE: St. Gobain, Paris



For instance —

Allis-Chalmers gives you maximum overload capacity and maximum resistance to abrasion, moisture, vibration and to both electrical and mechanical fatigue in "Silco-Flex" insulated motors.

The Allis-Chalmers all silicone rubber insulating system made with Silastic*, is now available in most motors of 500 hp and larger. They offer longer life and more economical operation under severe operating conditions in power plants and mines, and in such continuous process industries as cement, chemical, food, paper and rubber manufacturing.

*TM REG. U.S. PAT. OFF.

"When we decided to Metalclad the 34.5 Kv Primary Gear of our Foundry substation, we saved valuable ground space and had a much better looking installation"

—says Charles Pflug, Plant Engineer at American Motors, Kenosha, Wis.



S&C Metalclad equipment was chosen for this job because it served the purpose so adequately . . . especially with S&C engineering to assure the protection and operating conveniences required.

Here it was desirable to control the switching from a point several blocks from the actual installation. Accordingly S&C

Load Interrupters were supplied with hydraulic operators to permit remote push-button control.

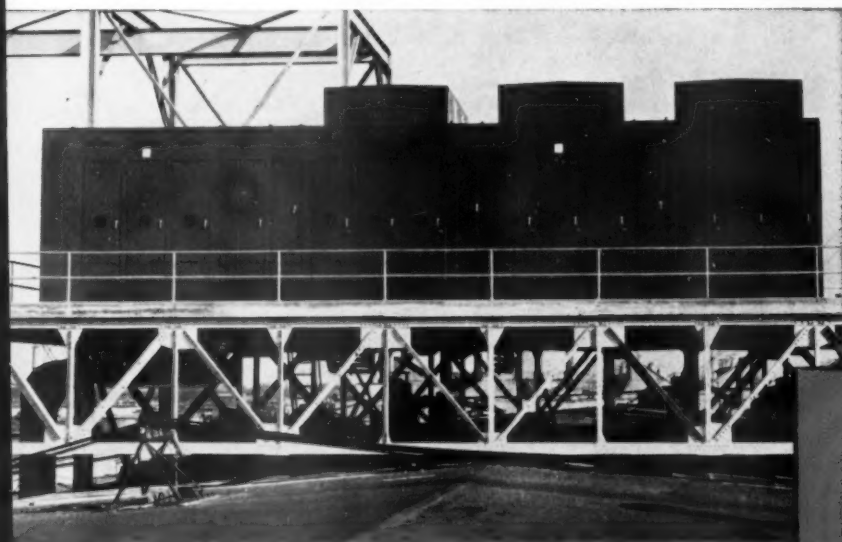
For the sake of appearance as well as protection against lightning and weather, it was preferable to have all the gear enclosed. An even more compelling reason for enclosing the gear was the unavailability of

ground space for open structure.

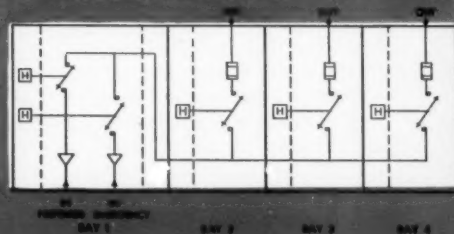
When it was decided that metalclad equipment should be used, mounted above a building roof, it was immediately realized that the unit should be as small and compact as possible to minimize the requirement for supporting structure.

All of these considerations pointed to S&C Metalclad equipment as the logical choice . . . for convenience, for appearance and for protection. This was the judgment of Mr. Charles Pflug, Plant Engineer, and also of the utility engineers with whom he consulted.

S&C was happy to co-operate in designing and building the outstanding installation pictured at left.



S&C Metalclad equipment takes up 50 feet along the roof of one of the American Motors buildings in Kenosha, Wis. Bay 1 contains the two incoming lines providing primary preferred and emergency throwover service at 34.5 kv. Bays 2, 3, and 4 are bus connected to 1200 kva 3-phase transformers.



*Specialists in High-Voltage Circuit Interruption
since 1910*

S&C ELECTRIC COMPANY

4433 RAVENSWOOD AVENUE • CHICAGO 40, ILLINOIS, U. S. A.

In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ontario

POWER FUSES • DISTRIBUTION CUTOUPS AND FUSE LINKS • LOAD INTERRUPTERS • METALCLAD SWITCHGEAR



Now, *quality*



high-voltage cable at less cost: with **new RoZone-RoSeal**

Excellent for industrial use

Superior moisture resistance compared to other types of nonmetallic sheaths: That's just one advantage of RoSeal, Rome Cable's new special thermoplastic sheath for shielded power cable rated up to 15 KV.

RoSeal has particularly high resistance to oils and most chemicals, making it especially adaptable for installation in chemical plants, refineries, paper mills, steel mills and the like.

In its new RoSeal, Rome has perfected a sheathing material which better fulfills all requirements for a shielded power cable sheath, eliminates many disadvantages of other sheathing materials, and reduces cable cost.

In the case of RoZone-RoSeal cable, the new RoSeal sheath is ap-

plied over Rome's premium quality oil-base type insulation, RoZone. Thus, the new RoSeal sheath, combined with time-proven RoZone insulation, offers seven other advantages, in addition to its outstanding moisture resistance.

1. The coefficient of friction of RoSeal is considerably lower than other sheathing materials. This makes it much easier to pull in ducts or conduit.

2. RoSeal is easier to bend and install at subzero temperatures. Minimum recommended installation temperature is -40°C .

3. RoSeal has proved satisfactory for both underground and overhead use.

4. RoSeal is durable and long lasting —has a life expectancy at least equiv-

alent to polychloroprene sheath.

5. RoSeal is flame resisting.

6. RoSeal provides a rugged mechanical barrier. Its tensile strength, hardness and other mechanical properties are designed for the job.

7. RoSeal is resistant to micro-organism attack. Its resistance to weathering and soil conditions is also equal to that of polychloroprene sheaths.

Electrical tests made in the Rome laboratories show uniformly higher corona level and dielectric strength for RoSeal jacketed power cables.

We invite you to prove for yourself the value of RoSeal. Write today for a sample of RoZone-insulated, RoSeal-sheathed power cable. You'll find it's everything we have stated here.

It Costs Less to Buy the Best

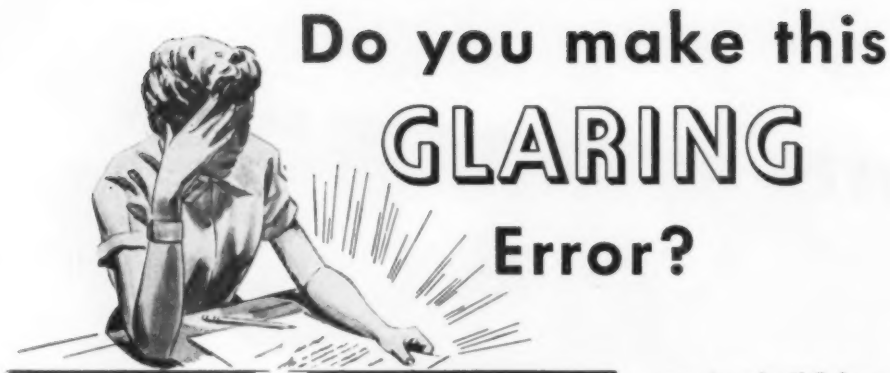


ROME CABLE

Corporation

ROME • NEW YORK

TORRANCE • CALIFORNIA



Do you make this GLARING Error?

Litecontrol's Simple Solution

Providing adequate illumination is only part of any lighting problem. Harsh contrasts can easily turn a good installation into a glaring error.

In this office, LITECONTROL uses its fixture No. 3700 with Holophane low-brightness CONTROLENS to furnish the right light—yet eliminate all glare and sharp contrasts. Seeing is relaxed and easy at every point in the room.

Extremely shallow, this smart "surface troffer" fix-

ture is only 4¼" deep. *Trigger Catches* open and close doors *at the snap of your fingers*. No screws or adjustments of any kind necessary.

On your next project, plan on having a better lighting installation, too, at *standard* fixture costs—call in your local LITECONTROL man.

LITECONTROL FIXTURE SERIES 3700

EASY TO OPEN, just a touch on the LITECONTROL Trigger Catches and doors spring conveniently open. No screws or adjustments necessary.

EASY TO CLOSE, simply push the LITECONTROL door shut. Trigger Catches snap and grip instantly, safely, dependably.



Installation: Honey-Krust Bakery, Lexington, Kentucky; **Area:** Office; **Engineer:** J. T. Cole, Lighting Engineer, Kentucky Utilities Company, Lexington, Kentucky; **Electrical Contractor:** Clyde Johns, Lexington, Kentucky; **Fixtures:** No. 3728 2-lamp surface fixture, using Holophane No. 9016 Low Brightness Lenses, and 96T12 slimline lamps. No. 3724 fixture, same, but with 48T12 slimline lamps; **Spacing:** 8'-6"; **Intensity:** Average 62 footcandles, after 2½ months of operation.


LITECONTROL
Fixtures
LITECONTROL CORPORATION
36 PLEASANT STREET, WATERTOWN 22, MASSACHUSETTS

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

SPANG[®] CONDUIT

The easy bending qualities of Spang Conduit were put to the test in the construction of three public parking garages where construction plans required tricky bends around columns and beams. But, from all three construction sites the electrical construction crews reported fast, trouble-free conduit installations with SPANG HD (Hot-Dipped, Heavy-Duty) Galvanized Conduit.

That's because of SPANG's *quality-control* manufacturing which produces a uniform product every time. There are no hard spots to create bending problems, breaks or splits. And SPANG HD's uniform galvanized and lacquered finish does not chip, flake or peel even under the most severe bending strains.

Let SPANG be your first choice for all conduit installations. Contact your nearest SPANG Distributor for *top-quality* service.

PITTSBURGH: Allies Garage, Boulevard of the Allies and Smithfield Street. Six levels, 528 spaces. Designed as a giant ramp with half of each floor sloping down, other half sloping up. Motorist can park his car on any level. Two self-service elevators serve all levels. SPANG HD Galvanized Conduit is installed along columns and ceilings for lighting and elevators. Cost: \$741,000. In operation July, 1955.

Owner: Pittsburgh Parking Authority
Architect: Hoffman & Crumpton
Contractor: Ragnar Benson, Inc.
Electrical Contractor: Fischbach and Moore, Incorporated
Spang Distributor: Keps Electric

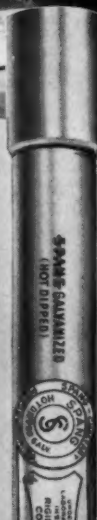
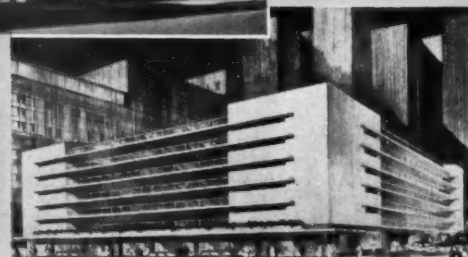
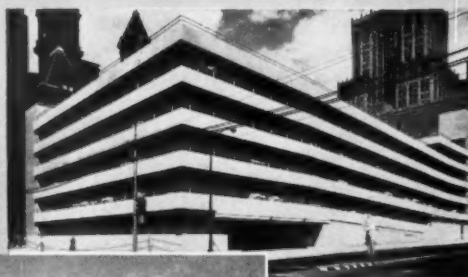
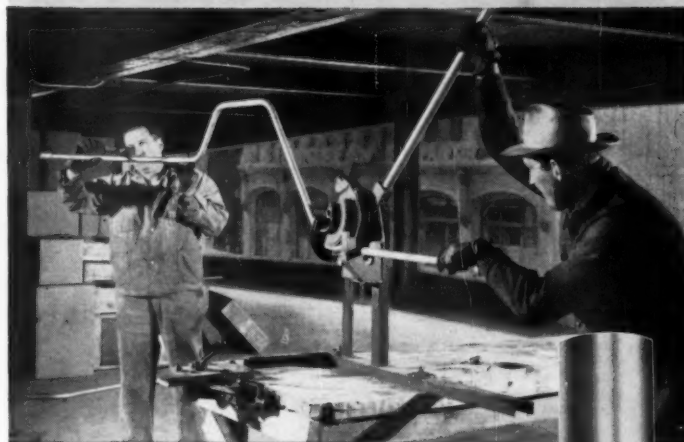
CHICAGO: Parking Facilities No. 1, 11 West Wacker Drive. Fourteen levels, 717 spaces. World's largest mechanical parking garage. Served by five Bowser System automobile elevators which travel horizontally as well as vertically within the shaft. SPANG HD Galvanized Conduit is imbedded in concrete, serving elevators, intricate controls and lighting. Cost: \$1,665,557. In operation February, 1955.

Owner: City of Chicago
Architect: Shaw, Metz & Dolio
Contractor: Herlihy Mid-Continent Co.
Electrical Contractor: Knott & Mielly
Spang Distributor: Effengue Electric Supply Company

PITTSBURGH: Diamond Street Garage, Diamond and Smithfield Streets. Seven levels, 864 spaces. Conventional design for service in retail shopping center of Downtown Pittsburgh. Three self-service elevators. Includes seven first-floor stores facing on Smithfield Street. All SPANG HD Galvanized Conduit runs imbedded in concrete supply service to stores, elevators and general lighting. Cost: \$1,395,000. In operation November, 1955.

Owner: Pittsburgh Parking Authority
Architect: Hoffman & Crumpton
Contractor: United Construction Company
Electrical Contractor: Fischbach and Moore, Incorporated
Spang Distributor: Keps Electric

*—easy bending qualities
aid construction of 3
public parking garages*



SPANG[®] CONDUIT
SPANG-CHALFANT
Division of The National Supply Company
GENERAL SALES OFFICE:
TWO GATEWAY CENTER, PITTSBURGH, PA.
District Offices and Sales Representatives
in Principal Cities

When All things are ...the better lighting

Louvers on Varsity units may be opened from either side to facilitate servicing.

Benjamin translucent louvers are easy to keep clean by simply dipping in detergent-and-water solution.

All these things considered...

- 1. Specific Units for Every Need
- 2. Precision Construction
- 3. Low Installation Cost
- 4. Minimum Maintenance Cost
- 5. Lowest Over-All Cost

make **BENJAMIN** the choice for better lighting!

considered

choice is **BENJAMIN!**



Exclusive
"easy-in, easy-out"
Springlox lampholders
speed up and
simplify lamp removal
and replacement.



Send for
your FREE copy
of one or all
of these interesting
lighting bulletins!

consider:

Minimum maintenance cost!

When you look into the maintenance features of Benjamin Line lighting units, you will find important cost-cutting advancements such as shown above. These features not only make sure that the lighting system will stand up year-after-year, but also that the cleaning, re-lamping and servicing operations can be performed at lowest possible cost. Such time and labor-saving features are typical of the entire Benjamin Line . . . they are another reason why Benjamin advises specifiers and buyers to consider *all* things when selecting lighting equipment. They prove that a few pennies more invested in Benjamin quality, returns many dollars in better performance at minimum maintenance cost.

Benjamin Electric Mfg. Co., Dept. H, Des Plaines, Ill.

XB-1038



Even recessed
units, like
Trofferlites
are engineered
to make
reflectors easy
to clean,
lamps readily
accessible.

BENJAMIN

TRADE MARK

LIGHTING EQUIPMENT

SOLD EXCLUSIVELY THROUGH ELECTRICAL DISTRIBUTORS

BUSGEAR

CO-ORDINATED ELECTRICAL SYSTEMS OF **BUSWAY and SWITCHGEAR**

In modern industrial and commercial buildings, there are two major components of electrical distribution systems, *busway* and *switchgear*.

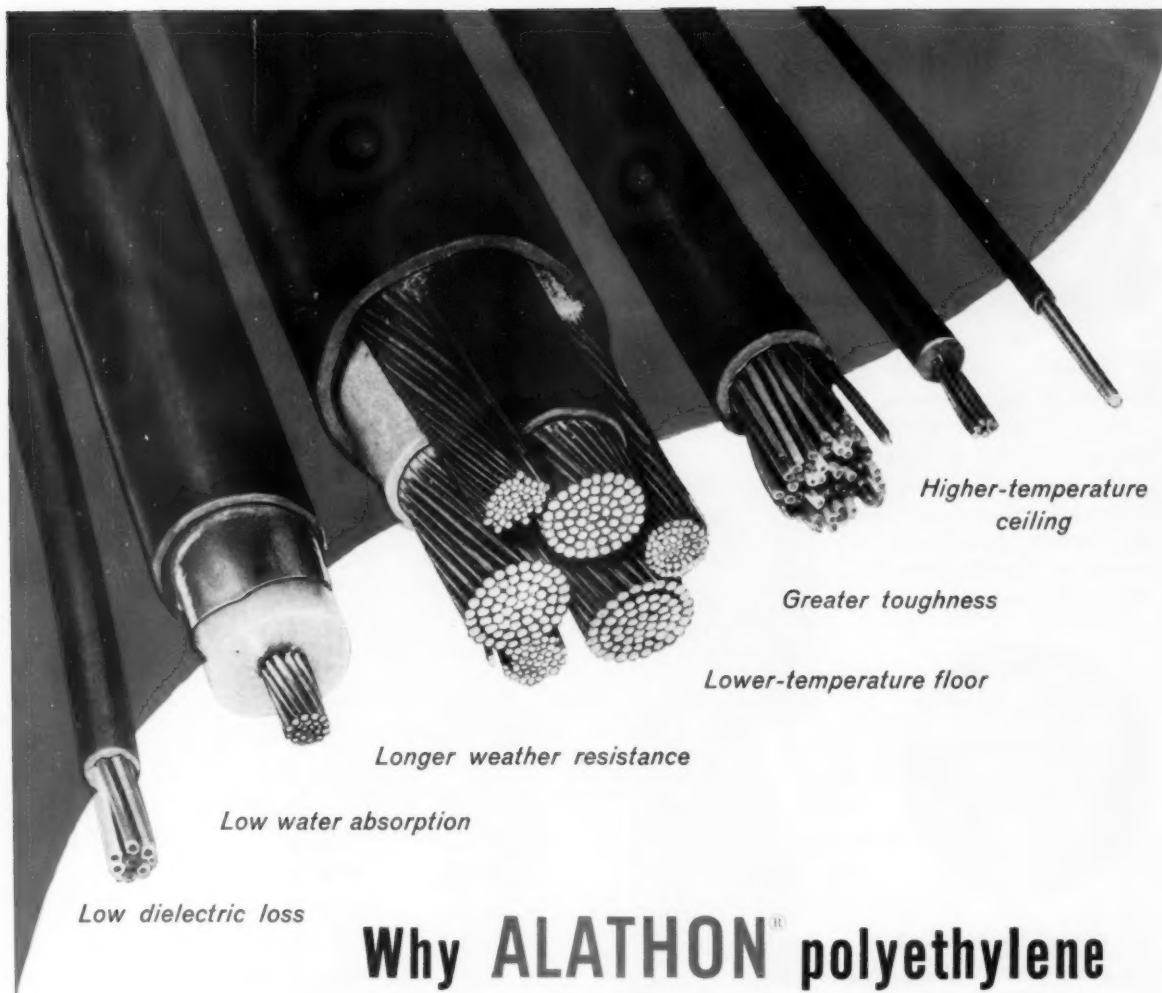
Uni-Bus busway provides a new concept in electrical distribution. Industrial and commercial installations are more flexible, safer and truly economical with the new Uni-Bus busways.

For numerous tap-offs, as in industrial plants, the Uni-Bus plug-in system is ideal. To carry current from one point to another with only a few tap-offs, as in lighting risers in office buildings, the Uni-Bus feeder system is most economical.

To obtain maximum efficiency from the Uni-Bus system, co-ordinated overload and short-circuit protection is essential. This is accomplished best with Roller-Smith switchgear expressly designed with that aim in view. Extensive testing at Roller-Smith is the basis for sound engineering co-ordination between Uni-Bus *busway* and *switchgear*.

That's why we selected the name **BUSGEAR** to identify the completely co-ordinated system manufactured by Roller-Smith under *one* roof and under the supervision of *one* Engineering Department.

Roller-Smith
CORPORATION
BUSWAY and SWITCHGEAR
BETHLEHEM, PENNSYLVANIA



Higher-temperature ceiling

Greater toughness

Lower-temperature floor

Longer weather resistance

Low water absorption

Low dielectric loss

Why ALATHON[®] polyethylene is superior for insulation and jacketing

New properties of "Alathon" polyethylene resin make it superior for insulating and jacketing of aluminum or copper conductors.

The higher melting point of Du Pont "Alathon" permits higher temperature ratings. The

low brittleness temperature and improved abrasion resistance of "Alathon" assure years of trouble-free service. Jacketing of Du Pont "Alathon" is pliable, lightweight, and tough.

For more information, clip the coupon.

There is a difference in polyethylenes—

specify **ALATHON[®]**
polyethylene resin



REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING

... THROUGH CHEMISTRY

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department,
Room 449 Du Pont Building, Wilmington 98, Delaware
In Canada: Du Pont Company of Canada Limited,
P. O. Box 660, Montreal, Quebec.

Please send me information on Du Pont "Alathon" polyethylene resins. I am interested in evaluating these materials for

Name _____ Position _____
Firm Name _____
Street Address _____
City _____ State _____
Type of Business _____



WALTER D. VANCE, JR., Vice President • California Electric Co., reports:

**"We saved 14 days installing
527 fixtures by using
'UP-RIGHT' Scaffold-on-Wheels"**

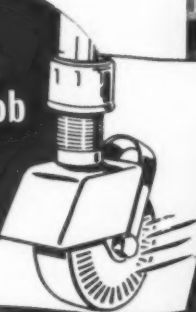
Man-hour savings on this General Motors warehouse job amounted to over 40%. Up-Right Scaffold is so light it is easily assembled by one man. Individual 1 piece aluminum alloy sections are unfolded and set one on top of the other. They lock into place instantly.

**14' tower
assembled in
2 minutes**

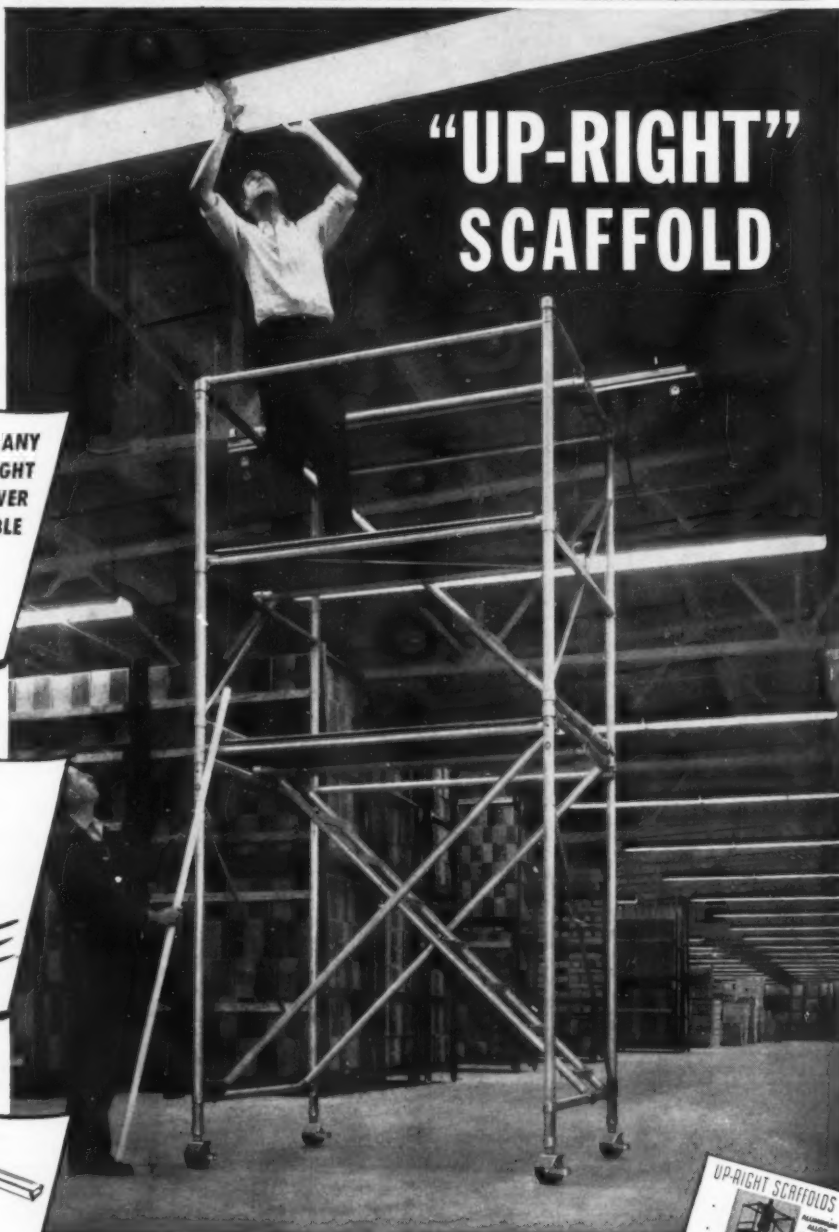
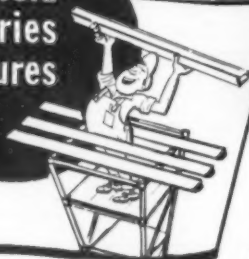


**ANY
HEIGHT
TOWER
AVAILABLE**

**Rolls
with job**



**Scaffold
carries
fixtures**



Write for descriptive circular ➡

"UP-RIGHT" SCAFFOLDS

Dept. 159 • 1013 Pardee Street • Berkeley, California

Factories: Berkeley, Calif. and Teterboro, N. J. • Offices in all principal cities



**Balance is important
in MOTOR STARTERS, too!**



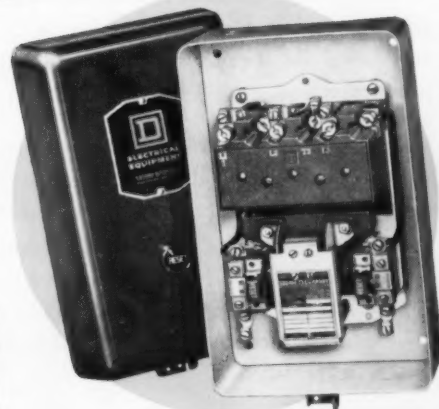
**Only Square D Balanced Design
Gives ALL the Features without sacrificing Any One!**

EASY INSTALLATION. Plenty of wiring space with no sacrifice of compactness.

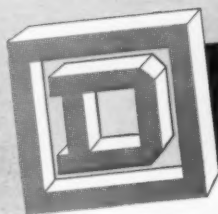
SIMPLE MAINTENANCE. Coils, contacts, interlocks, overload relays easily changed without disturbing external connections. Normal maintenance made still easier with standardized parts kits. No complicated identification, ordering or stocking.

FLEXIBILITY. A wide range of special requirements can be met in the field, using standard starters and parts kits available from local distributor stock.

THEY COST NO MORE . . . WHY SETTLE FOR LESS?



ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS



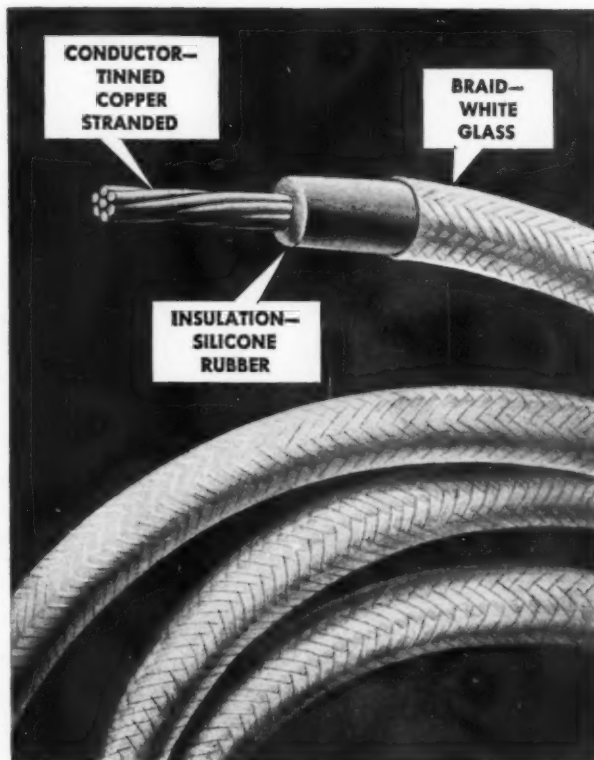
SQUARE D COMPANY

New G-E silicone rubber wire reduces lighting fixture failures caused by heat and moisture

Heat and moisture can cause trouble and service expense in the fixtures you sell. When heat and moisture are trapped in and around fixtures, ordinary wiring may fail, causing damage to the fixture itself and even to surrounding structures. You can help protect your lighting fixtures against this hazard by equipping them with new General Electric silicone rubber wire.

This new wire will operate safely at conductor temperatures as high as 200 degrees centigrade, and has excellent resistance to moisture and heat aging. Flexible, clean-stripping, and easy to handle, it can save valuable time on the production line.

New General Electric silicone rubber wire meets the acute demand for a fixture wire rated at least 150 C for use in wet locations. (It is listed by Underwriters' Laboratories, Inc.) For complete specifications and a sample, write Section W175-918, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.



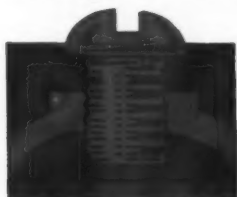
Progress Is Our Most Important Product

GENERAL  **ELECTRIC**



Meet the man
who just discovered

Tube-weld fittings!



This happy master-electrician has just had the pleasant experience of using his first Tube-Weld fitting. You, too, will agree that Tube-Weld's new concept in fitting design is the real answer to fitting problems. They are precision-made of one piece heavy gauge welded steel tubing which has been accurately drawn and sized for controlled uniformity. These fittings cannot open or spread and far surpass UL requirements.

Tube-Weld fittings represent an entirely new idea in quality, design and price. They are available in $\frac{1}{2}$ ", $\frac{3}{4}$ " and 1" sizes, and have the following features:

- Extra long offsets provide exceptionally easy pulling of wire.

- Longer length of fitting provides maximum support for conduit.
- Connector shoulders are uniformly flat assuring perfect centering in the box.
- All threads are rolled instead of cut and have 54% greater stripping strength and 66% greater snapping strength (independent laboratory report) over cut threads.
- Lustrous zinc finish and carefully beveled edges add a distinctive appearance — allow largest inside working diameters.
- Carefully and smartly packaged for ease in shelving and identification. For descriptive brochure and additional information, write or call:

ELECTRIC TUBE PRODUCTS

A Subsidiary of Berger Machine Products

74-16 Grand Ave., Maspeth (N.Y.C.), N. Y., DEfender 5-8000



CONNECT WITH **ETP** FOR ECONOMY

EXTENSION-PIECE

CONNECTOR

COUPLING

OFFSET CONNECTOR

WE'RE KNOCKING HIM RIGHT INTO YOUR LAP!

Here's how Kennecott helps you make the most of SKIMPY WIRING!

He's an ugly, weak-wired villain, and he lives in more than 80% of the homes in your area! But for all his nasty habits, Skimpy Wiring can mean money to you!

By causing no end of electrical annoyances, Skimpy Wiring sets up your local homeowners as Grade A prospects for *profitable re-wiring business!*

Unfortunately, most of Skimpy Wiring's vic-

tims don't recognize him for the scoundrel he really is. They must be told, and Kennecott is telling them!

Full-page ads like the one you see below are putting the spotlight on Skimpy Wiring, giving him the blame for the electrical troubles he causes. You benefit *directly* from these Kennecott ads since all of them wind up by telling the reader to *call in an electrical contractor!*

It will pay you to tie in with Kennecott!



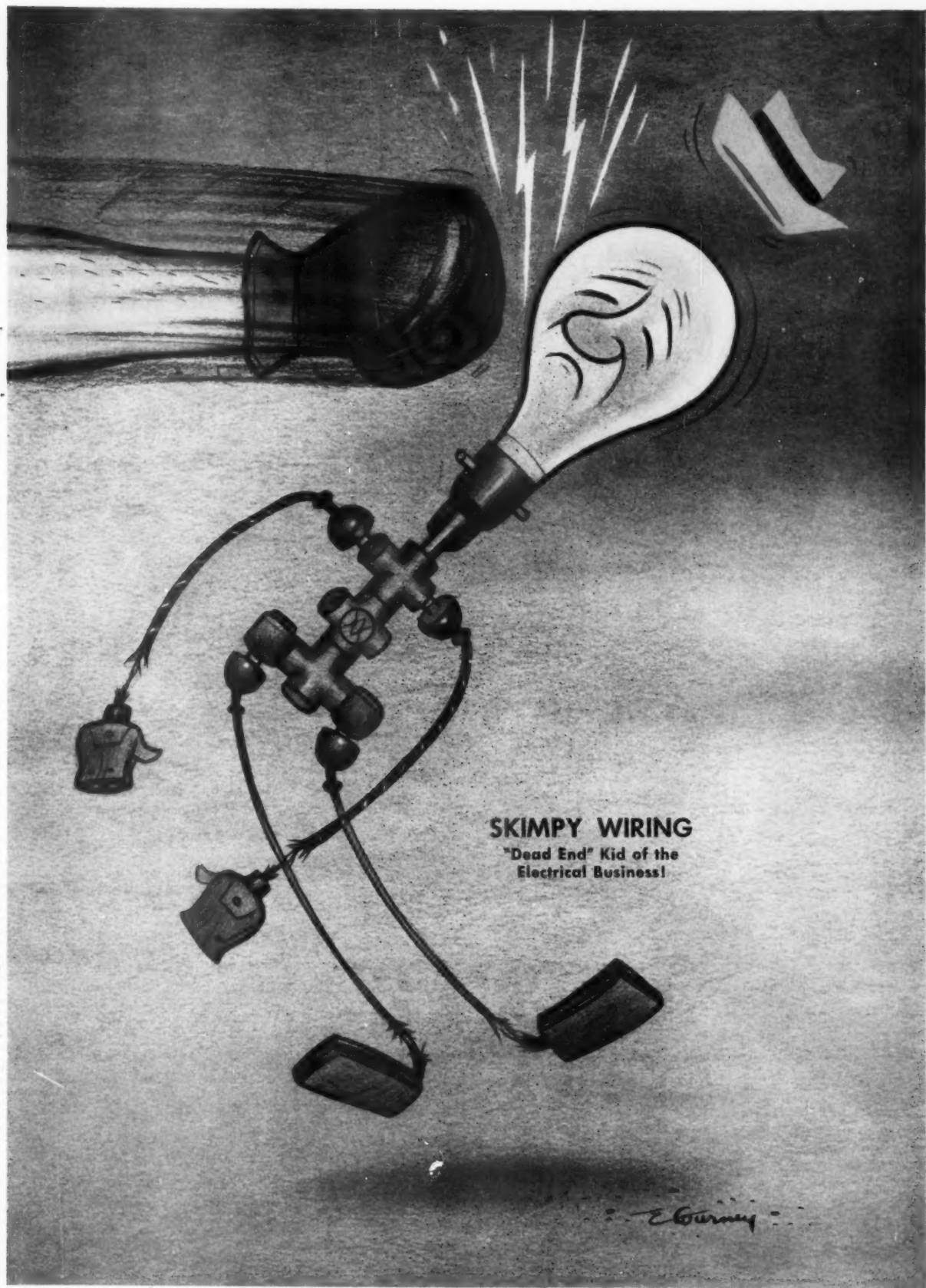
FREE TIE-IN MATERIAL!

Add punch to your own local drive for adequate home wiring! Send today for free reprints and poster-sized blowups of Kennecott's full-page Saturday Evening Post and This Week magazine ads. Get free copies of the educational booklet, "The ABC of Home Wiring." Ask for complimentary Home Wiring Wall Chart, mat service folder and list of *at-cost* prices for large-quantity orders of all material available. No cost or obligation! Just write Kennecott Copper Corporation, Dept. EC95, 161 East 42nd St., New York 17, N. Y.



Kennecott Copper Corporation

Fabricating Subsidiaries: CHASE BRASS & COPPER CO. • KENNECOTT WIRE & CABLE CO.



SKIMPY WIRING

"Dead End" Kid of the
Electrical Business!

For top value . . . in any type . . . get JENKINS

Gold Seal Tape

FRICTION • RUBBER • PLASTIC

GOES FURTHER

**STICKS FAST—
IN ANY
WEATHER**

**GUARANTEED
FOOTAGE**

**WON'T RAVEL
TEARS EVENLY**

BEST BUY FOR PLANT SUPPLY

All types of **GOLD SEAL TAPE** — Friction, Rubber, Plastic — are packed in 10-roll cartons as well as single rolls. Every roll cellophane-protected, stays fresh. Jenkins Bros., Rubber Division, 100 Park Ave., New York 17.

DIAMOND SEAL
Friction and Rubber Tapes are also made by Jenkins Bros. to ASTM specifications.



Management called this a luxury until they tried to add a machine

This tool works *knew* about modern distribution systems and circuit breaker protection. But management was never fully convinced.

Instead, they'd settle for another line out of the old switchboard every time a new production machine was added. They did, that is, until now. For now they'd had it. They were *really* overloaded.

In fact, what management thought was a cost-cutting practice had mushroomed into the most expensive and dangerous heating system ever devised by man.

Either it was a matter of doing something drastic to that electrical system right now . . . or losing a lot more than the units another shaper machine could produce.

DP-5011-A

**Here's the chain reaction
that new machine started →**

YOU CAN BE **SURE**...IF IT'S
Westinghouse





Increased load pointed up the urgency of shortening secondaries with power centers

Power centers, of course, let them carry high-voltage close to the production machines.

Results: Shorter secondaries. Less line losses and voltage drop—conditions urgently needed in this plant.

A power center, I pointed out, contains high-voltage terminals, plus a dry-type transformer and

low-voltage circuit breakers. All are in a metal enclosure for safety.

There's no need for a special vault, either. So the power center was mounted over the toolroom. And the money value of the floor space saved may well offset the value of the old switchboard that was replaced.

DP-5011-B

YOU CAN BE SURE...IF IT'S



A need for fast machine change-overs proved the economy of plug-in bus duct

Sure. Cable and conduit *could* have been used for the new secondaries in this plant.

But the need for fast change-overs made plug-in bus duct more economical in the long run.

Westinghouse plug-in bus duct, I showed, is a power carrying method you can plug machines into

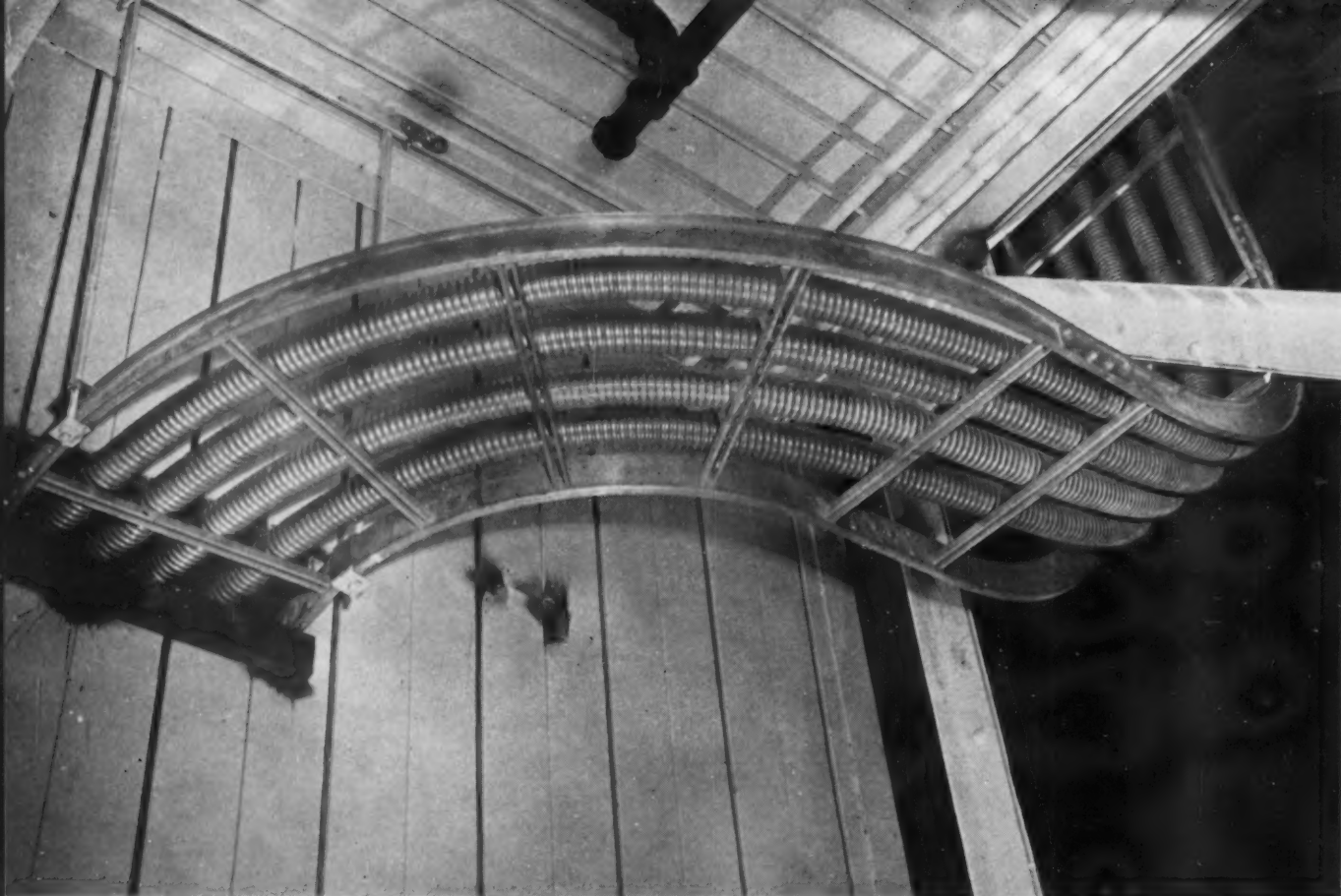
whenever you wish. To change a machine—unplug it. Move down the line. Plug in again. That's all.

And installation costs are low.

Where it might take 56 man-hours to install 400-amp wire and 3-inch conduit, the same amount of 400-amp duct was hung in about 30 hours.

DP-5011-C

Westinghouse 



ANACONDA INTERLOCKED-ARMOR Cable is installed on simple racks and eliminates the need for conduit. Installation work is finished often in half the time required for other cables.

Instead of installing cable plus conduit...

Cut installation time and cost with cable with its own inbuilt flexible conduit!

When you expand or relocate your power feeders, Anaconda Interlocked-Armor Cable puts you into *full* operation days—sometimes weeks—sooner.

Because it is made with its own tough yet flexible armor, Interlocked-Armor Cable is installed without conduit. Installation time and costs are slashed.

It is laid quickly—indoors or out—on light, easily installed racks. It is

trained smoothly around corners, columns and other obstructions in *long, uninterrupted* runs. And this cable's metal tape armor affords high protection against damage.

Available in multiconductor construction in sizes No. 6 Awg to 750 Mcm—varnished-cambric insulation up to 15 kv—Underwriters' approval for 600 volts and 5000 volts. Also available with rubber or plastic types of

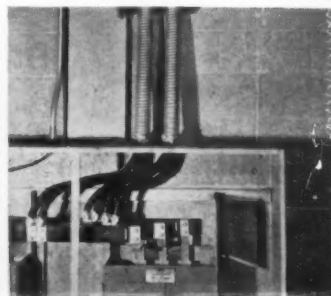
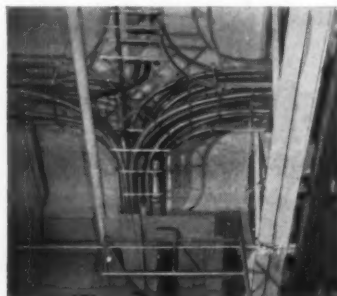
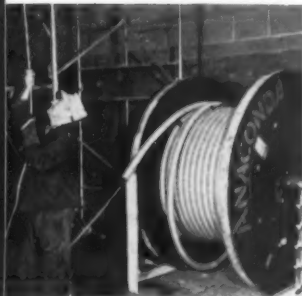
insulations.

Why not talk to the Man from Anaconda about modern, practical Interlocked Armor Cable today? Or, for information, write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

55281

ANACONDA®

METALWORKING PLANT expands its power system with Anaconda Interlocked Armor Cable (1). Cable drops from ceiling (2) from transformer on floor above, and spreads out (3) carrying more power to local centers (4).



Now...the spectacular new Cutler-Hammer ★ ★ ★ Unitrol



Standardized Modular Construction

All control units are 20" wide and in multiples of 14" in height. This permits easy interchange of various sizes and types of control units without rearrangement of the entire control assembly and avoids wasting space with dead panels to adapt non-uniform control units. This standardized modular construction also insures good appearance at all times because horizontal lines match.

Star studded with features that provide fastest installation or rearrangement of motor control, maximum space economy, unparalleled motor control performance and new safety for men and equipment.

Fifteen years ago Cutler-Hammer Unitrol pioneered the idea of flexible control centers... the modern way to organize control equipment for better performance, greater safety, and quick rearrangement to meet industry's constantly changing control requirements. Few engineering advances ever received such enthusiastic acclaim or such rapid widespread use. Through the years there have been many imitations, but only *one* Unitrol.

Today Cutler-Hammer engineering leadership opens another new era in flexible control centers with the great new Cutler-Hammer ★ ★ ★ Unitrol. Star studded with features that permit new speed in installation, new speed in any reorganization of the equipment, more control units in less space, new safety for men and equipment and new motor control performance that simply has no equal. Whether you desire truly modern control for just a few machines, a full department or an entire factory, be sure you have all the facts about the new Cutler-Hammer ★ ★ ★ Unitrol before you buy. Write or wire today . . . CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.



Unitrol Uni-Plug Saves Time

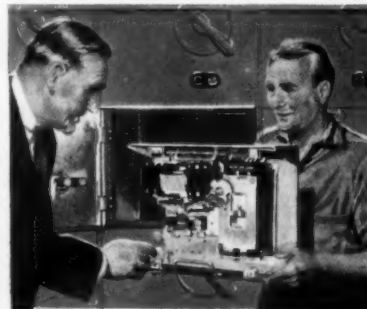
Uni-Plug automatically connects each control unit to its power supply when the unit slides into operating position. It also assures complete disconnect whenever the unit is pulled forward for inspection or attention. All units can be locked in "disconnect" position. Unitrol Uni-Plug thus saves wiring and rewiring time—and insures safety.



Self-Aligning Disconnect Operators

Unitrol control units can be equipped with either fused disconnect switches or circuit breakers. Both types have self-aligning three-position operators which are arranged for padlocking with as many as three locks in "off" position.

The name UNITROL is a Cutler-Hammer trade mark.



New C-H Three-Star Control Units

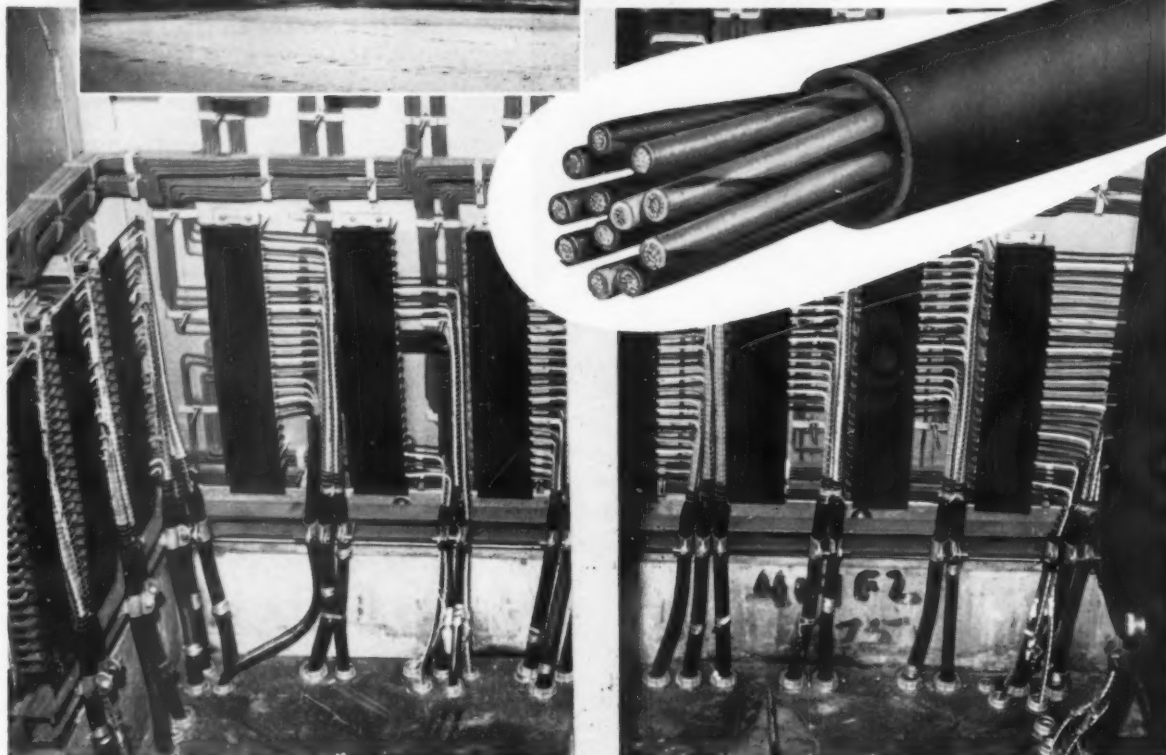
New Superlife Vertical Contacts end care and costs for all time in normal control uses. Adjustable Load Sensing Coils with 3% overload accuracy (compared to usual 12%) permits motors to work harder safely. Full 3-Phase Protection now costs as little as \$6 (list price) additional per control unit. Compare this with the cost of just one motor burn-out.



FLORIDA POWER CORPORATION

EXPANDS CAPACITY

Higgins Plant, Oldsmar, Florida



USES **ROCKBESTOS PNR[®]** SMALL DIAMETER CONTROL CABLE

Since 1946 Florida Power Corporation has been expanding its generating capacity so that at the end of 1955 it will have a generating capacity of 491,000 kw.

To insure safe dependable operation of its control circuit Florida Power Corporation installed 207,600 ft. of No. 9AWG Rockbestos PNR Small Diameter Control Cable.

You, too, can benefit with Rockbestos PNR. This outstanding control cable lets you pull 12 conductors in conduit where before you had only seven. You save conduit and fittings . . . cut installation costs. Get the full story today. Write or call your nearest Rockbestos Field Engineer.

*Average determined by comparison with conventional control cable.

PROPERTIES OF PNR

46% smaller in area* . . . 28% smaller in diameter* than conventional control cable.
Use smaller conduit and fittings or put more conductors in existing conduit.
Lighter, easier to handle, store, ship, pull through conduit.
Dielectric breakdown . . . over 40 times operating voltage.
Rated 600 volts . . . conductor operating temperature 167°F.
Flexible from 167° to -67°F.
No cracking!

ROCKBESTOS PRODUCTS
NEW HAVEN 4, CONN.



CORPORATION

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You can pull these plugs at full load . . . SAFELY!



NEW, Re-Designed Arktites...

Feature new pressure connectors — new easier-to-wire 1-piece interior assemblies — new easier-to-interchange plug and receptacle interiors — new plug adaptability to any type and size cable.

Fully interchangeable with older style. Same price. Currently available in 30 and 60 amp. sizes, in 2-, 3- and 4-poles.

Circuit-Breaking Arktite

PLUGS AND RECEPTACLES

20 amp. to 400 amp.—250V D.C.; 600V A.C.

SAFE at all times—even if you pull an Arktite plug to disconnect an energized motor or appliance in an emergency!

You don't have to open the disconnect switch before withdrawing an Arktite. Arcs created as line and load poles disengage are confined in deep, insulated arcing chambers—are instantly snuffed out by pressure-deionization and lack of oxygen. There's no possible danger of flashover injuring personnel or destroying property.

Contact your Crouse-Hinds Distributor, nearest Crouse-Hinds Office or Representative for complete information.

● Operated like a giant switchboard, this Arktite installation with variations in power, frequencies and voltages is used to speed up machine tool testing. Plugs can be inserted and withdrawn from "live" receptacles without using a disconnect switch.



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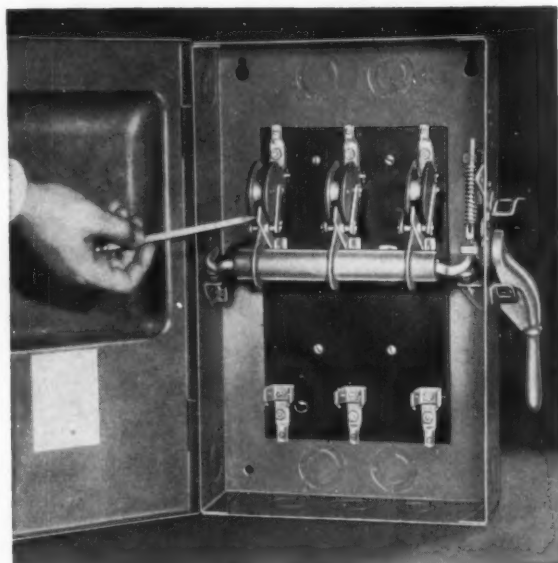
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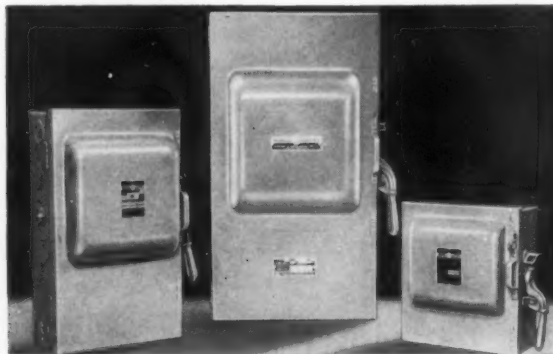
Crouse-Hinds Company of Canada, Ltd.

CONDULETS • FLOODLIGHTS • TRAFFIC SIGNALS • AIRPORT LIGHTING

This G-E checklist will help you get heavy duty safety switches that last up to 30 years




- 1. Have they proved themselves in years of tough service?** Industry reports show that many Trumbull Style A heavy duty switches have given reliable service for over 30 years. Reasons? Such features as the heavy steel operating yoke that can't break and that insures opening and closing the switch. Strong fibre crossbar covers the yoke, maintains perfect blade alignment.
- 2. Will they operate coolly, efficiently?** The impact-resistant slate base on Trumbull heavy duty safety switches rapidly bleeds off heat, temperatures can't build up to dangerous levels. All copper current carrying parts are silver plated to eliminate oxidation and to further reduce temperatures. Maximum current is always carried because of heavy jaw pressures, sure fit.



- 3. Are they quality made of the most rugged materials?** Every Trumbull switch is made under severe quality control conditions using the finest metals. Hinge and jaw posts are milled, sweated and pinned (Type A construction) to stand up under the toughest abuse. Yoke bumpers eliminate jarring and the handle is of cast iron construction.
- 4. Can your plant standardize on them?** Complete range of selection for every switch application makes it easy for your plant to standardize on Trumbull Style A heavy duty switches. Common parts, similar maintenance procedures reduce costs, electricians' time. Rated from 30 to 1200 amps and up to 600 volts. Single and double throw operation, 2, 3 or 4 pole design, either fusible or no fuse.

AVAILABLE FOR QUICK DELIVERY FROM YOUR G-E TRUMBULL DISTRIBUTOR

GENERAL  **ELECTRIC**



ALUMINUM BUS DUCT DISTRIBUTION SYSTEMS

for Today's Needs and
with Tomorrow's Expansion
in mind

You can save time, material and money—both today and tomorrow—if you plan now on the flexibility of a bus duct electrical distribution system.

In industrial plants, bus duct systems minimize downtime for machinery relocations because outlets are always at hand and circuit changes are made quickly and easily. Wire waste is kept to a minimum thus reducing costs. Bus duct is also practically 100% salvageable—can be removed from existing installations and used elsewhere without appreciable loss of material. Tomorrow's plant expansion is more economical, too, because prefabricated duct sections can be extended swiftly, with minimum service downtime and at a lower installed cost than cable and conduit or wireway.

The flexibility of bus duct electrical distribution systems is practically unlimited. They are easily adaptable to both horizontal or vertical layouts for industrial, office and commercial buildings—for small buildings or large, for one-story spreads or skyscrapers.

New RABC (Reynolds Aluminum Bus Conductor) Offers Important Advantages in Bus Duct Distribution Systems

Just as bus duct distribution is the most economical method, new RABC is also the most economical conductor material.

The basic advantages of RABC include more conductivity per dollar; long range availability; light weight which permits faster, lower cost installation—requires less time, less equipment and fewer men to install. New RABC also provides greater strength than other aluminum conductors with very little effect on electrical conductivity. And since RABC is available in an unlimited range of sizes and shapes, it is no longer necessary to use oversize conductor because of intermediate size limitations.

Additional Data Available from Reynolds

Reynolds does not make bus duct distribution systems, but we would like to send you more information about their advantages. Write for literature and, if desired, names of system manufacturers to *Reynolds Metals Company, P. O. Box 1800-ET, Louisville 1, Kentucky.*

REYNOLDS



ALUMINUM

MODERN DESIGN HAS ALUMINUM IN MIND



"Maintenance needs Megger Testers

... as Surgery needs the X-ray"



Megger
Insulation Resistance Tester

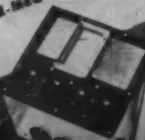
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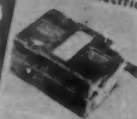


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TEMPERATURE-RESISTANCE
CHARACTERISTICS
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The word "MEGGER" is a registered trademark. There is only ONE "MEGGER" family of electrical resistance measuring instruments... and in the U.S.A., the words "BIDDLE" and "MEGGER" have been synonymous with electrical resistance testing since the beginning of the century.

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INSULATION RESISTANCE TESTERS

Standard the World Over

One of the outstanding merits of all types of Megger instruments is quality of a high order. The performance and endurance records which these instruments have achieved are difficult, if not impossible, to match in any type of portable testing device. For insulation resistance measurements, Megger instruments are the recognized standard.

AN INTEGRAL PART OF ELECTRICAL OPERATIONS EVERYWHERE

Throughout industry Megger Instruments have earned the distinction of being the most widely accepted devices for making electrical resistance measurements. They are the universally accepted instruments for preventive maintenance programs and the regular maintenance of electrical equipment. By their periodic use, and from the records of their measurements of the insulation in all important equipment, trouble may be anticipated and avoided, and production stoppages and losses reduced.

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Over forty years of experience in the field of electrical testing is represented in the manuals, bulletins, and other technical literature published by the Biddle Company. These are some of the extras you get with your purchase of a Megger Instrument. Practical engineering assistance is always available without obligation.

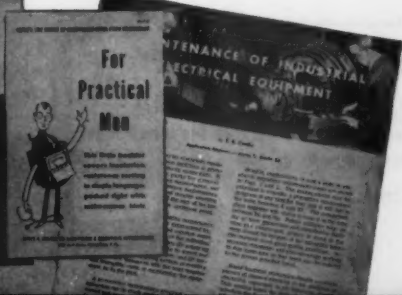
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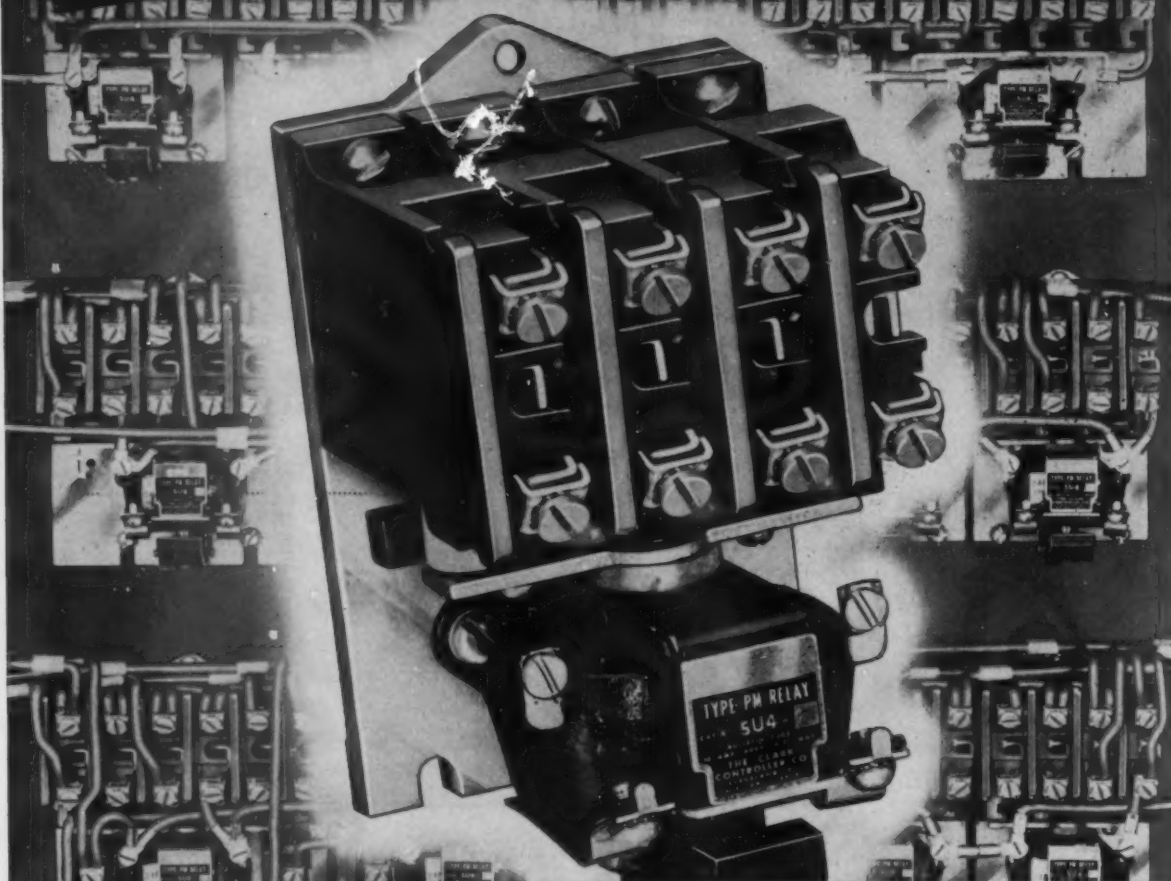
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Another **CLARK** First!



NEW! Heavy-duty relay in small space

This new CLARK Type "PM" Control Relay introduces a new concept in relay design: *Sectional Pole Construction*.

In this new relay, each pole is contained in its own melamine housing, and any individual pole can be removed or replaced from the front without disturbing the others. A short circuit is confined to a single pole and will not destroy the whole relay. Wiring terminals are on the front, and all maintenance including coil changing, pole or magnet replacement, is also from the front—without removing relay from panel. Contacts are quickly and easily convertible from normally open to normally closed and vice versa—from the front. Range of models provides relays with 2 to 12 poles. Exclusive design allows more contacts per square foot of panel space. In addition to the many advantages of **SECTIONAL POLE CONSTRUCTION**, you get a heavy-duty relay in small space.

For complete information write to
The CLARK  **CONTROLLER Company**
Engineered Electrical Control 1146 East 152nd Street • • Cleveland 10, Ohio

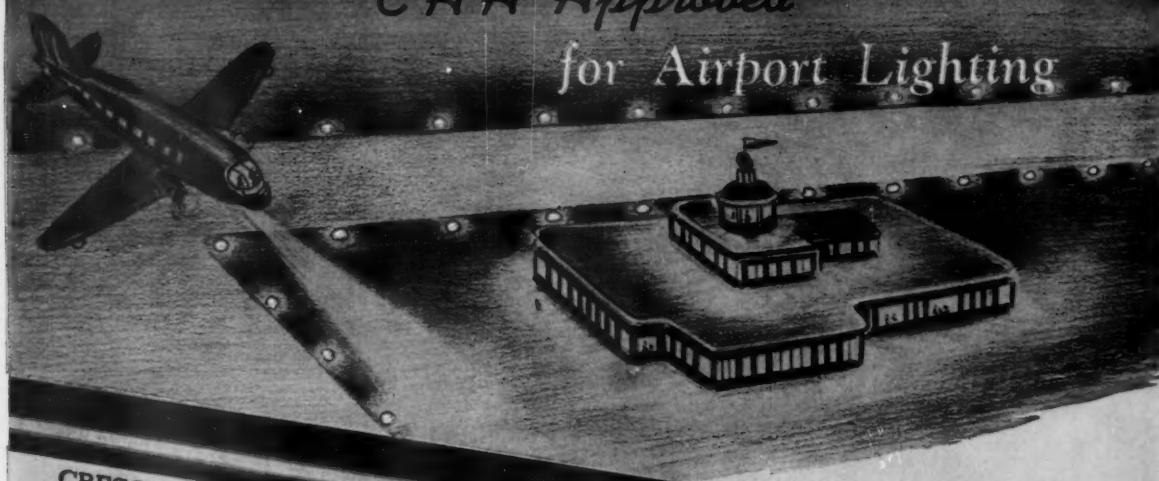
SEE THIS NEW RELAY AT THE CLARK EXHIBIT, PRODUCTION ENGINEERING SHOW, BOOTH 840
Navy Pier, Chicago—September 6-16, 1955

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IMPERVEX TRENCHWIRE AND TRENCHCABLE

C A A Approved

for Airport Lighting



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CRESCENT IMPERVEX TRENCHWIRE and IMPERVEX TRENCHCABLE are well known underground cables approved for 600 volts as TYPE "A" PERFORMANCE cables under C A A Specification L-824.

For 3000 volt and 5000 volt TYPE "B" OZONE RESISTANT cables under C A A Specification L-824 use CRESCENT HYVOLT TRENCHWIRE and HYVOLT TRENCHCABLE.

Tens of millions of feet have been giving outstanding trouble-free service for many years. Write for bulletins No. 491 and No. 492.



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TRENTON, N. J.



G-E LAMPS GIVE YOU MORE FOR ALL YOUR LIGHTING DOLLARS



How General Electric built a \$3 saving for you into a \$1.15 lamp

THE amount of light you get from a General Electric 40-watt fluorescent lamp today would have cost you about \$3 more only five years ago, counting lamps, maintenance labor and electricity. Here's what made the difference:

29% MORE LIGHT. Today's G-E fluorescent lamp starts off 19% brighter than the 1950 lamp. And it depreciates slower. Over the life of the lamp you get a total of 29% more light.

25% FEWER EARLY BURNOUTS. In rigid laboratory tests, today's G-E lamps show only 15% failures at 80% of life, compared to 20% failure of 1950 lamps. (Actually, it would take the average plant from two to four years to burn out their G-E fluorescent lamps today!)

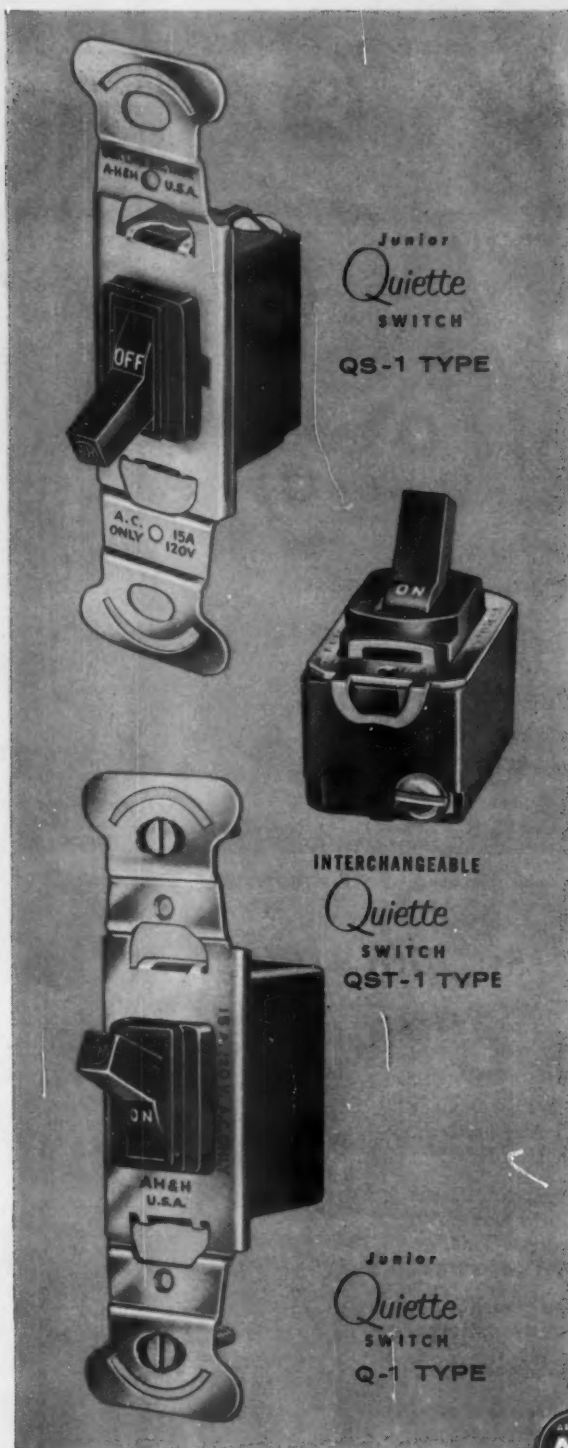
COST LESS. Since 1950, the net cost of the G-E 40-watt fluorescent lamp has gone down 4¢, for case-quantity buyers.

The photo above shows where two improvements were made. The light-giving phosphor coating inside the glass is much brighter. The cathode, the chemical-coated spiral of wire that carries the electricity, lasts longer and has more uniform life.

For more facts on how General Electric gives you more for all your lighting dollars, write for a free 16-page Progress Report to Lamp Users: Large Lamp Department, General Electric, Dept. 482-EC-9, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL  ELECTRIC



EASY
to install
SURE
to satisfy



LIGHT SWITCHES
NOW BY POPULAR DEMAND
WITH BINDING SCREWS

(Available with or without binding screws)

Whatever your design preference . . . whatever your installation, maintenance or performance requirements . . . every type of Arrow-Hart QUIETTE Light Switch has features that satisfy — Screw or Screwless Wire-Lock Terminals, and silver alloy contacts for substantial load capacity.

And for your customers — safe, quiet operation of incandescent or fluorescent lights and appliances through mechanical action, decorative Brown or Ivorylite handles, and Arrow-Hart quality that means dependable service and long life.

RATINGS

LIFETIME ratings: 15 amp — 120-277 volt ac only;
20 amp — 120-277 volt ac only.

INTERCHANGEABLE ratings: 15 amp — 120-277 volt ac only;
20 amp — 120-277 volt ac only. Certain screwless switches are available with shunts.

Junior ratings: 15 amp — 120 volt ac only. Screwless switches are available with either line or ground shunts.

Mail coupon for folder giving complete details.

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Flanked by a Day-Brite Catalog at his right hand,
Bud Murphy tells of his experience with Day-Brite.

"We have never been disappointed in a Day-Brite installation"

Bud Murphy, Secretary-Treasurer and General Manager
of Robbins Electric Company, Inc., Indianapolis, Ind.,
has this to say about Day-Brite lighting:

"Charting our course of business practice on a long-term basis
(we've been contracting since 1913), we repeatedly turn to Day-Brite
products to secure customer satisfaction and repeat business. This, we
have found, is the true strength of an electrical contractor's operation.

"We don't believe in sacrificing quality as a means of creating a
greater margin of profit. This is often a tragic mistake.

"We have never been disappointed in a Day-Brite installation."

SEE, EXAMINE and COMPARE Day-Brite—the cornerstone of good
customer relations and better business for every electrical contractor.

5485

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NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT



FITTINGS HAVE CHANGED TOO

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- 1 Heavy, (sample shown weighs 1 lb., 12 ozs.).
- 2 Rough interior & exterior.
- 3 Subject to rust & corrosion.

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ITS DAY

THEN... SAND-CAST ALUMINUM



- 1 Lightweight (size shown comparable in size and style to cast iron at left; but only 10 1/2 ozs.).
- 2 Rust and Corrosion proof.
- 3 Safe, non-sparking, non-staining.

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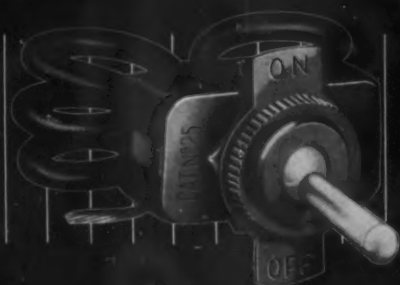


eliminate switch failures with
THE SWITCH THAT'S always READY

Pampered in production to withstand abuse in use, the Levolver® #41 switch retains its positive action even after hundreds of thousands of pulls. It is unconditionally guaranteed against failure in lighting circuits. Its one-piece molded phenolic case insures better insulation, makes wiring easier. Removal of the mounting nuts lets the mechanism slip out, exposing terminals. A 6 amp "T" 125 volt switch, it is only $\frac{3}{8}$ " x $1\frac{3}{8}$ " x $1\frac{3}{8}$ ". Ideal for individual control of lighting fixtures.



Levolver No. 25



Specify **Levolver** for
Dependability in Toggle Switches

The Levolver® No. 25 Toggle Switch is "T" rated for 6 amps — 125 volts and especially dependable for FHP motors on quality appliances, portable tools and for panel boards. Only $\frac{1}{2}$ " thick, $\frac{1}{2}$ " wide and 1" long. The molded phenolic case is dust and vibration proof. 6" wire leads with choice of colored levers for easy identification of circuits. Available also in three way and two circuit models with lugs or screw terminals.



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MCGILL
QUALITY

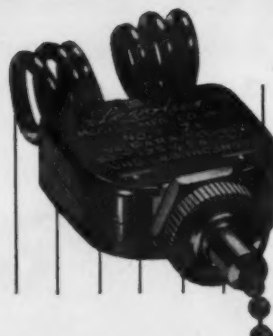
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4100



NEW
Industrial LAMP HOLDERS with
Levolver® Switch Dependability

Whether you prefer universal lever or the new push button control, you can have a Levolver Lampholder that has a proven record of long service in strenuous industrial use. Levolver switch mechanisms are built into both brass and molded phenolic heavy duty lamp holders in a variety of single or two circuit models. All are built to eliminate failures in plant and machine lighting that can mean costly production time losses.



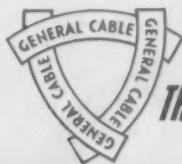
For **FASTER, EASIER WIRING** specify
Levolver® No. 71 switches

A single pole, single circuit switch, the Levolver® No. 71 model is the thinnest 6 amp "T" 125 volt switch on the market today. Only $\frac{15}{32}$ " thick, it insures quicker and easier installation because of the 6" wire leads that are permanently fastened to the terminals by pressure connections. Standard finishes: brass, dark bronze and burnished nickel, with brown molded phenolic case. The No. 71, like all Levolver switches, is Underwriters' approved.

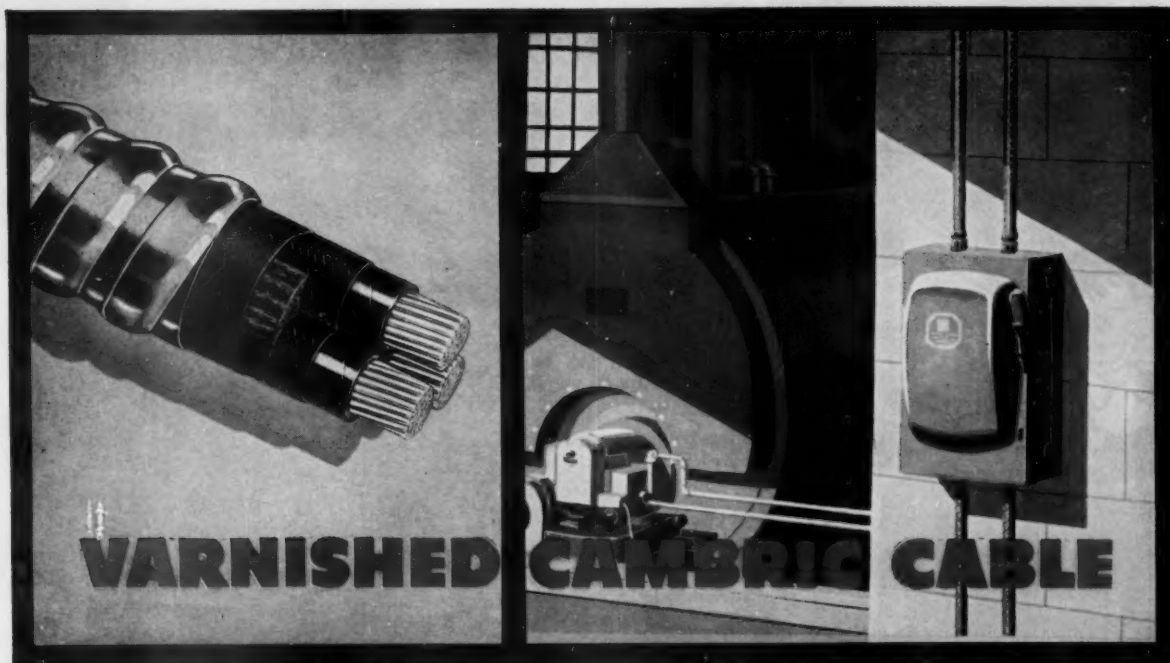
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MCGILL MANUFACTURING COMPANY, INC.
450 N. Campbell St., Valparaiso, Indiana



THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE



Extraordinary in its ruggedness, General Cable's Varnished Cambric Cable is designed for both low and high voltage requirements.

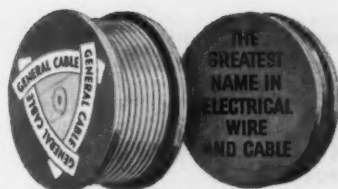
Some outstanding features of General Cable's Varnished Cambric Cable are: resistance to oils, greases, the effects of corona discharge; high dielectric strength, long cable life, and high safe operating temperatures which permit larger current carrying capacities. General Cable's Varnished Cambric is available in single or multi-conductor types with outer coverings of braid, tape and braid, lead, neoprene or a variety of armors, including steel, bronze

or aluminum. Interlocked Varnished Cambric Cable is ideal for wiring in close areas and under, down and around beams and pillars... where power needs vary... where plant layout presents space difficulties.

In fact, there is a General Cable Varnished Cambric Cable that is *exactly* right for your particular installation. Ask your friendly General Cable representative or distributor for complete information.

And don't forget... General Cable is the only manufacturer who can supply *all* your electrical wire and cable needs!

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EASIER, MORE CONVENIENT...

Only  **2020*** connectors
have all these cost-saving
features!



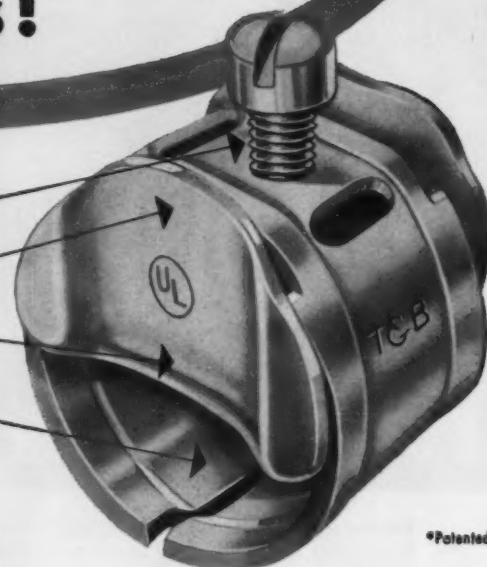
Only one screw to
tighten ... captive so it
can't come out

No lock-nut needed —
grooves hold connector in
 $\frac{1}{2}$ " knock-out

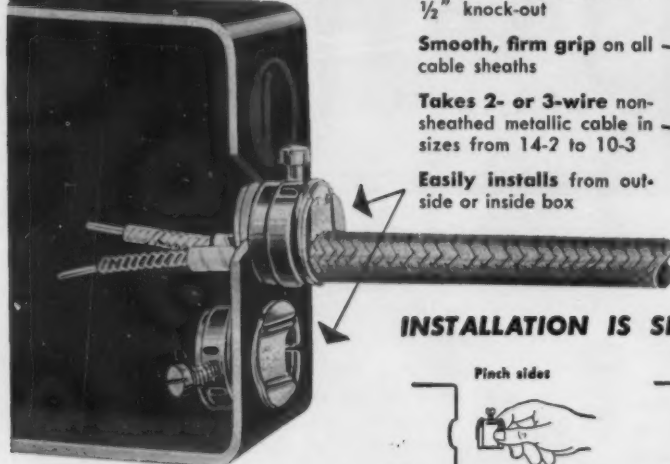
Smooth, firm grip on all
cable sheaths

Takes 2- or 3-wire non-
sheathed metallic cable in
sizes from 14-2 to 10-3

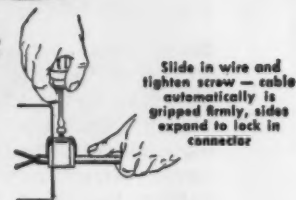
Easily installs from out-
side or inside box



*Patented



INSTALLATION IS SIMPLE AS A B C



T & B 2020's are steel snap-in type connectors for non-metallic sheathed cable. With an easy squeeze, the "2020" snaps into a $\frac{1}{2}$ " knock-out and is held fast by grooves. Because this connector installs from either inside or outside the junction box, it is especially good for work on old buildings where damage to walls and floors can be avoided by working from inside the box.

T & B 2020 Connectors have full Underwriter's Laboratories approval. They hold any non-metallic sheathed cable sizes 14-2 to 10-3; 2- or 3-wire cables, also portable cords, etc. — work especially well on currently popular small dimension plastic sheathed cables. Write for samples and descriptive literature.



LOOK FOR THIS SIGN —

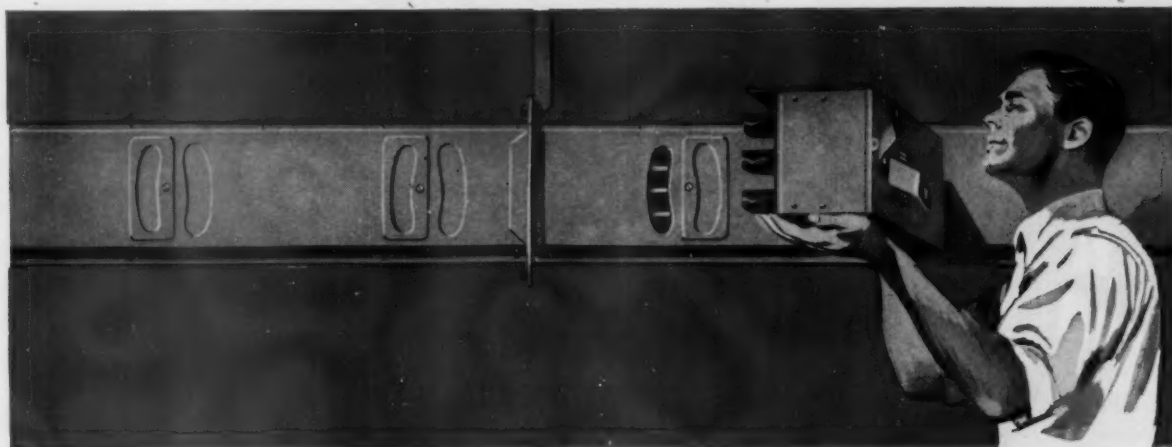
IT'S THE MARK OF AN AUTHORIZED T & B DISTRIBUTOR

The complete line of T & B fittings for conductors and raceways is sold only by recognized electrical wholesalers. It's our way of assuring you the service and savings of a friendly local source. Call him for all your electrical needs.

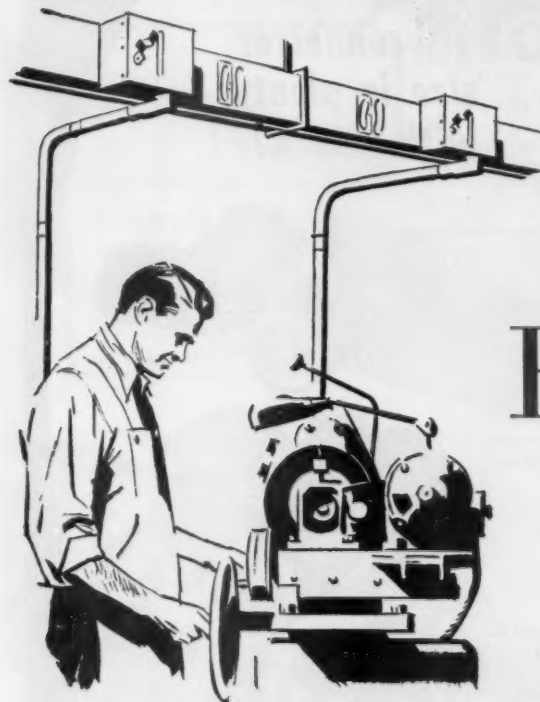
T-510

THE THOMAS & BETTS CO.
INCORPORATED

34 Butler Street • Elizabeth 1, New Jersey
Thomas & Betts Ltd., Montreal, P.Q., Canada
MANUFACTURERS OF FINE ELECTRICAL FITTINGS SINCE 1898



PLUG-IN POWER WHERE YOU NEED IT . . . IN MINUTES! Each section of plug-in duct is 10 feet long with five plug-in openings on each side. Exclusive scarf-lap construction joins sections in a rigid form. Standardized plugs are fastened to casing flanges at plug-in openings. Reinforced fingers engage bus bars for positive pressure contact.



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ALUMINUM CONDUCTORS GIVES**

Lightweight, Flexible Power at low cost!

CUTS DOWNTIME! 100% REUSABLE! SAFER, MORE EFFICIENT POWER!

Sell customers on providing for *future* as well as present electrical requirements. Recommend and install Bulldog Plug-in Duct—the completely flexible, reusable electrical distribution system that provides instant plug-in power wherever, and whenever, it's needed.

Simple to install, rugged plug-in duct allows circuits to be swiftly added or removed without rewiring. Downtime is cut,

too! New tool setups can be made, machines shifted, lighting revamped, without interrupting the flow of power.

Whatever the power requirement, present or future, your customers are always prepared with Bulldog Plug-in Duct. Your nearby Bulldog Field Engineer will provide experienced assistance. Or write: Bulldog Electric Products Company, Detroit 32, Michigan. ©BEPCC

IF IT'S NEW
... IF IT'S DIFFERENT
... IF IT'S BETTER ... IT'S



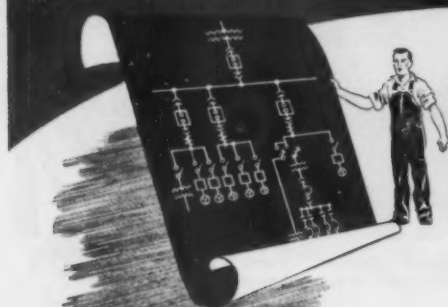
BULLDOG

ELECTRIC PRODUCTS COMPANY
A Division of I-T-E Circuit Breaker Company

Export Division: 13 East 40th Street, New York 16, New York. In Canada: Bulldog Electric Products Company (Canada), Ltd., 80 Clayson Road, Toronto 15, Ontario.

ONE O.Z. FITTING DOES THE WORK OF 32

**For Tee or
Parallel Taps!**



32 connector
sizes needed on
this job!



ONE connector
size is plenty
with this XTP!

One typical XTP connector replaces up to 32 different parallel or tee connectors because each XTP accommodates a wide range of wire sizes. All told, the XTP line of but 25 connectors will receive over 400-wire size combinations!

For either tee or parallel taps, just snap special hinged clamp over main and tighten the connector permanently in place—positive contact is assured. When you're ready to connect the tap, simply insert wire in tap end of connector. A wrench-turn or two, the job's done!

25 CONNECTOR SIZES do practically all tap jobs.

- Accommodate over 400 combinations of wire sizes
- Fit wire from #8 to 1,000,000 CM

HINGED CONSTRUCTION for quick installation.

SPRING STEEL LOCK WASHERS (tin plated) maintain pressure.

- Hold resiliency—assure permanent connection

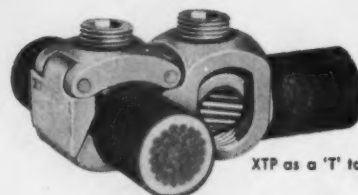
PRESSURE PLATES designed for maximum contact and grip.

- Serrated for firm grip
- Can not rotate during installation

HIGH STRENGTH, HIGH CONDUCTIVITY.

- High conductivity copper alloy for body
- Extra strength copper alloy for pressure plates and hinged parts

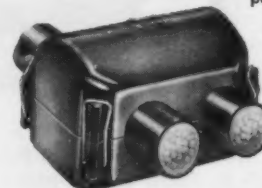
Get these combination fittings from your wholesaler now... and put an end to bulky assortments of tap connectors.



XTP as a 'T' tap



XTP as a parallel tap



High-strength Bakelite insulating covers for XTP fittings. Compact, install with stainless spring clips, no taping.

*They're O. K.
if They're O. Z.*



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San Francisco Plant: 501 Indiana Street, Market 1-4709

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Excellent resistance to flex cracking, abrasion, chipping, cutting.

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Neoprene jackets have sufficient insulation resistance to prevent corrosion from electrolytic action.

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It resists both causes of jacket failure equally well.

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OVER 20 YEARS of successful field experience in all kinds of rubber products—that's one reason why you can count on long, dependable service from neoprene-jacketed wire and cable. A study of neoprene's remarkable properties will tell you why it outlasts ordinary jacketing materials . . . why specifying neoprene-jacketed wire and cable is the best way to give customers the dependability they expect. For full details about neoprene-jacketed wire and cable, get in touch with your wire and cable supplier.

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MITCHELL lights this modern office



MITCHELL LIGHTS ANOTHER OFFICE

All-Steel Equipment Inc.
Aurora, Illinois

Architect: Johnson & Johnson, Chicago, Illinois

Electrical Contractor: Michels Electric, Aurora, Illinois

INSTALLATION: MITCHELL "UNI-FLOW" Fluorescent Troffer Lighting with metal louver shielding (30°/30° visual cutoff). An average of 50 footcandles is maintained.

The new MITCHELL UNI-FLOW fluorescent troffers offer the most complete, versatile, uniform stock line of fine quality recessed units ever made. Every detail of design and construction has been precisely planned to make each MITCHELL UNI-FLOW installation a perfect job, both functionally and architecturally. The All-Steel Equipment, Inc. installation is a typical example of the superior results attained by MITCHELL UNI-FLOW Troffer Lighting.



F. A. SAAF, Chief Engineer

As Chief Engineer of All-Steel Equipment Inc., famous makers of quality office files and furniture, Mr. Saaf has carefully selected the most efficient equipment for this ultra-modern plant.

"For our office lighting," Mr. Saaf states, "we had two objectives in mind: first, a high level of uniform, glare-free illumination, and second, a smooth-flowing, attractive installation. Both of these requirements were met fully by the MITCHELL 'UNI-FLOW' Troffer Lighting we selected."

for better office lighting,

SPECIFY MITCHELL

Write for complete details on MITCHELL
office and other commercial lighting



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Laytex[®] **ROYAL MASTER**
PORTABLE CORDS

*Have 3 times
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TESTS PROVE IT!

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- 38% greater tension or breaking strength
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Than the average of molded cords of other makes

Your United States Rubber Company sales engineer will call on you to prove CONCLUSIVELY that U. S. Laytex Royal Master is the finest portable cord ever made. Don't place any order for portable cords until you get the full facts about U. S. Laytex Royal Master. Get in touch with us at the address below, if one of our sales engineers hasn't already visited you.



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Rockefeller Center, New York 20, N. Y.



*When Circuits
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**Save the Expense of
Ripping Up Conduits!**



Simplex WD-75 (Type RHW) squeezes 18% to 52% more amperes through the same size conductor, depending on ambient temperature.

It's used for general-purpose wiring in *BOTH* wet and dry locations at a copper temperature of 75°C. (167°F.).

Simplex WD-75 is made for 600-volt service in conduits or for burial directly in earth.

It's furnished as single conductor, flat twin, round two-conductor and three-conductor types.

WD-75 rubber insulation resists heat and water. Its extra-tough neoprene jacket is an exclusive Simplex compound.

Find out today how to get more current in less space with Simplex WD-75.

Write for Booklet No. 1018 to the address below.

Simplex - **ANHYDROPRENE**
TYPE WD-75 CABLE

SIMPLEX WIRE & CABLE CO., 79 Sidney Street, Cambridge 39, Mass.

ACTION

You will be hearing more about a dynamic new organization in the months ahead. Called ACTION, the American Council to Improve Our Neighborhoods is dedicated to the nationwide improvement of American homes.

The disturbing facts, according to ACTION researchers, indicate that we are losing ground against the forces of blight and decay. Some 20 millions of the 45 million non-farm homes in the United States today are in need of major repairs. Five million are rock-bottom slums.

Economic and social consequences of neighborhood blight affect all of us seriously. The terrible cost of slums is recognized by every literate citizen. But slums are only the more conspicuous outgrowths of the forces of decay which can be stopped only by aggressive and positive community measures.

To arouse the American people to pride in home ownership, to the consequences of decay and neglect and to the wisdom—and necessity—of proper home maintenance, repair and modernization is the big, long-range job that ACTION will take on. ACTION's President General Frederick A. Irving, Ret. says, "Our program is designed to help Americans help themselves. We hope to alert every citizen to the dangers of housing decay, both economic and social, and to cooperate with all types of national organizations and community groups in stopping the spread of blight. We seek to join forces with all those who share our concern for America's future."

The importance of the ACTION objectives to the electrical industry is tremendous. The big elements of housing utility and pride of ownership are modern central heating, modern plumbing and modern electrical appliances. From \$10 to \$15 billion must be spent in the next 10 years on wiring alone to fight back against obsolescence and decay. Focusing the interest of Americans on the repair and modernization of their homes will inevitably direct their attention to all types of modern electrical aids.

Top leaders in industry, commerce, labor and community affairs are directing the Council. It will gather facts for constructive action. It will generate awareness and motivate individual action. It will provide assistance to communities that wish to take action. It should have energetic local support from all electrical men.

Wm. T. Stuart



A COMPLETE SELECTION OF LIGHTING EQUIPMENT — Just consider the many different installations shown in this typical plant lighting system. Yet, from your local Graybar

office you can conveniently order equipment for these or any other lighting applications. See for yourself — you'll save time and paper work when you call *Graybar first*.

Everything you need for LIGHTING JOBS

25 INDUSTRIAL LIGHTING SOLUTIONS

This booklet contains case histories high-lighting 25 lighting system improvements in a series of industries ranging from an aircraft hanger installation to a packaging plant and including cafeteria, garage and washroom lighting. It will suggest many ideas for solving any lighting problems your customers may have — today, or in the future. Write for your free copy.



When your customer's employees see better, they also work better. And, when you base your fixture recommendations *on individual area needs*, you make an important contribution toward more efficient and more profitable plant operation. And, you'll help build the kind of confidence in your work that means more jobs in the future.

As distributor of the nation's most complete selection of lamps and lighting equipment, Graybar can therefore offer you and your customers comprehensive help in these vital planning and purchasing stages.

By calling a Graybar Lighting Specialist, you can get absolutely impartial advice on the fluorescent, incandescent, or mercury vapor system best-suited to any particular lighting requirement. You can be sure that the finished installation has been selected with consideration of both initial and operating costs... that it has been properly applied... and that it provides adequate over-all lighting intensity.

Graybar also distributes more than 100,000 other electrical items for wiring, power, ventilation, as well as lighting.

Make it a point to call Graybar for everything electrical — it's the easy way to coordinate both purchasing and job-site delivery. *Graybar Electric Co., Inc. Executive Offices: Graybar Building, New York 17, N. Y.*

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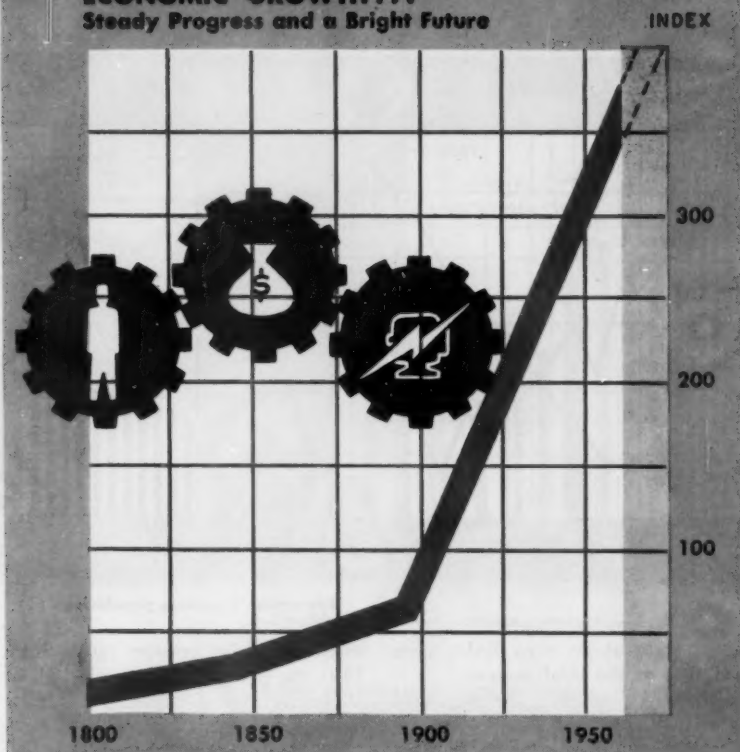
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ECONOMIC GROWTH . . .
Steady Progress and a Bright Future



ELECTRICAL INDUSTRY GROWTH PACES BOOMING ECONOMY

Analysis of long range national economy indicators provides the basic dimensions of our dynamic electrical industry, revealing steady progress and strong prospects for the production, sale and installation of electrical goods and services.

By Berlon C. Cooper

AMERICA is experiencing the greatest prosperity the world has ever known. Business is booming. Week after week, and month after month, national economy records are being broken. The total value of goods and services,—a yardstick by which prosperity is commonly measured, and referred to as gross national product (GNP)—was at an annual rate of \$385 billion during the second quarter of this year. This was some \$13 billion above the former peak rate reached in the second quarter of 1953, and

more than three times the annual rate of 1941. Supporting this prosperity boom were many factors—record employment, high income, a stable cost-of-living, record production, an expanding consumer market supported by a fast growing national population, and many others.

The electrical industry contributes significantly to the national economy, and is a dynamic factor in the current business boom. It not only produces and supplies electric energy to other industries, making possible rapid ex-

pansion of total national production, but also produces machinery and equipment for industry and commerce as a separate and distinct manufacturing industry all on its own. Thus the electrical industry and its market potentials are inherently affiliated with and, to considerable extent, dependent on many other national economy factors. Review and analysis of the trends of some of these important factors, and of the growth of major segments of the electrical industry itself, reveal its expanding markets and accelerating

CHART I - GROWTH RATE

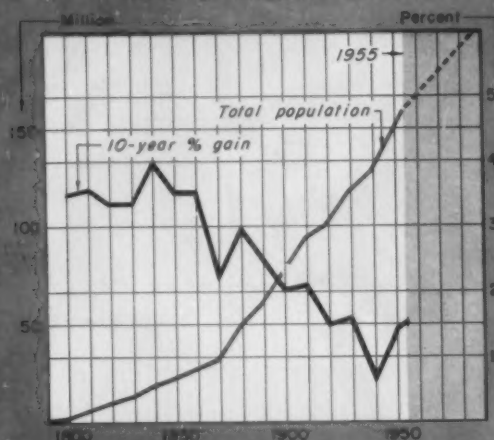
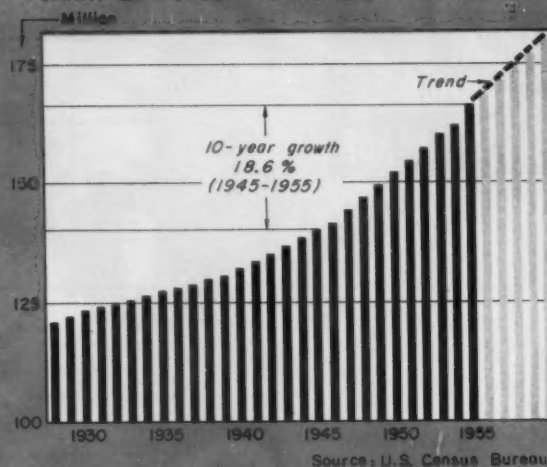


CHART II - POPULATION GROWTH IN THE U.S.



The nation's growing population . . .

growth rate at an even faster pace than that of the total economy.

Presented here are the historical records of several of these economic indicators, and of various segments of the electrical industry. In each case, where statistics were available, the records are shown over a sufficiently long period of time to show as clearly as possible the long-term average trend.

The National Economy

Charts giving data on national economy growth are presented, not because they contain new information not already made available, but to put their significance in better perspective. Each covers a longer period of time than is normally used. Also, wherever possible, the data are converted to a "per capita" basis, to eliminate the variable of population growth.

Prosperity is based primarily on expanding markets, backed up by ample purchasing power, which in turn creates a demand for increased production, and raises the standard of living. Conversely, it might be said that an increasing standard of living requires the production of more and more goods, which in turn provides higher incomes and develops an expanding market. Regardless of which comes first in this "chicken versus egg" cycle, America is also favored with another factor which exerts a strong influence on its economy. This important factor is a rapidly increasing population.

Population Growth—U. S. population has been increasing recently at a 2.7-million rate per year, or at about

three times its prewar rate. Since 1940, the economy has absorbed about 10 million new families, and a total of more than 30 million people (Charts I and II). This growing population, plus a continuing increase in the nation's living standards, has brought about the need for increased output per man-hour, for steady expansion of production, and for more and better machines. This, in turn, points up the need for more electric power and more electrical goods and machinery.

Gross National Product—The total output of goods and services (GNP—Chart III) reached a new high annual rate of \$385 billion, or approximately \$2,320 per person, during the second quarter of this year. This is an increase of approximately 145% over the 1941 rate of \$948 per person, or an average rate of increase of nearly 3% per year since 1930. Most major components of the economy shared in the 1955 second quarter business boom, Department of Commerce reported.

GNP and population increase are interdependent. Increasing population provides the labor force to support more production, and the market to buy it. Production, in turn, creates income, which gives the market its buying power.

GNP average trend for rate of growth can be seen in Chart III. Its growth will depend largely on output per man-hour, or "productivity". The key to higher "productivity" is, of course, the greater use of electric power, and of electrical technology.

Industrial Production—The Federal Reserve Board's index of industrial

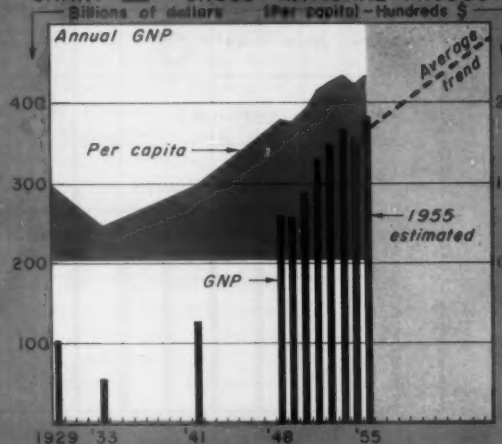
production hit 138 in May and June of this year, which is one point above the peak that the index reached in the 1953 boom. This compares with 100 for the 1947-49 average. When weighted for population change (see "Per Capita" in Chart IV), the 1953 index is 121, while the current index is 120, or one point below the 1953 peak. The major difference is that now the drive behind the boom is coming from consumers, while in 1953 a higher percentage of it was attributable to defense spending, principally for hard goods.

Employment—Total civilian employment in July of this year hit an unprecedented 65 million, up about one million over June, and three million more than a year earlier (Chart V). At the same time unemployment dropped to less than 2.5 million, or about 3.8% of the total labor force. Unemployment is now at its lowest level in eighteen months.

Personal Income—Personal income in July this year was at an annual rate of \$301-billion, down very slightly from the all-time high reached in May. Average hourly wages in factories were at \$1.88, a new record, up 8 cents from the 1954 average. It is estimated disposable income "per capita" (see Chart VI) will average about \$1560 this year, whereas total disposable income will be some 7% to 8% above 1954's total.

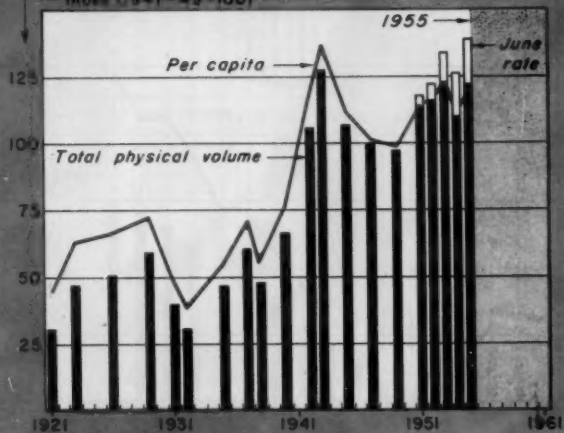
Consumer Credit—Installment debt, with a trend during recent months to lower down payments and longer maturities, has risen phenomenally to new highs month after month during 1955. Economists agree that the re-

CHART III - GROSS NATIONAL PRODUCT



Source: Dept. of Commerce

CHART IV - INDUSTRIAL PRODUCTION



Source: Federal Reserve Board

... Helps support a growing economy ...

... Provides market for increasing production ...

sulting rising volume of consumer credit (Chart VII) has been a big stimulus to the economy. Yet the rate of increase has them worried. It has risen at the record annual rate of over \$500 million a month over the past few months. Federal Housing Administration and Veterans Administration have tightened up on housing credit, as a result, by increasing down payments 2%, and trimming maturity from 30 to 25 years.

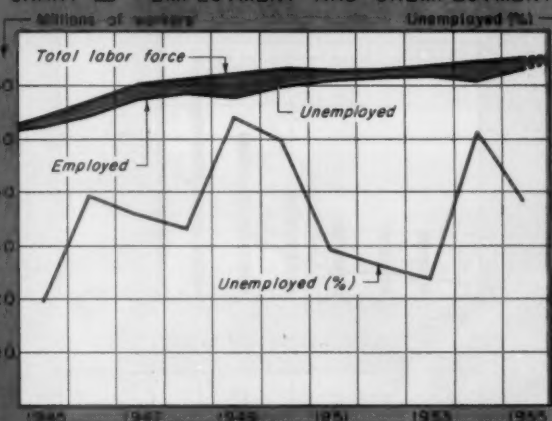
Cost-of-Living—During 1955 the economy (GNP) has soared upward some \$18 billion, employment has hit a new record, minimum wage rates have been upped from 75 cents to \$1.00 an hour, unions have won increased labor rates more or less across the board, and costs of many materials (steel, copper, aluminum, lumber, etc.) have increased. Yet the cost-of-living, as measured by Dept. of Labor's Consumer Price Index (Chart VIII) has changed less than three points in three years, is currently about even with the 1954 value.

Electric Power Growth

Growth of the national economy, as seen in the GNP and Industrial Production charts, has been at an annual rate of about 3% per year, on the average, and is currently at a slightly faster pace. Overall, however, the most optimistic forecaster would not predict a sustained economic boom over the next ten or more years, at a rate far in excess of the 3% per year average trend.

Electric power growth, however, is another story. Electric power generation and distribution is only one seg-

CHART V - EMPLOYMENT AND UNEMPLOYMENT



Source: Bureau of Labor Statistics

... Is a factor in record employment ...

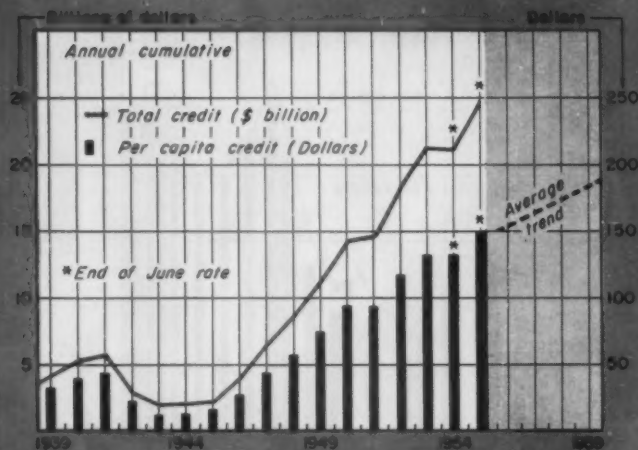
... Stimulates growth of purchasing power, but ...

CHART VI - PERSONAL AND DISPOSABLE INCOME



Source: Dept. of Commerce

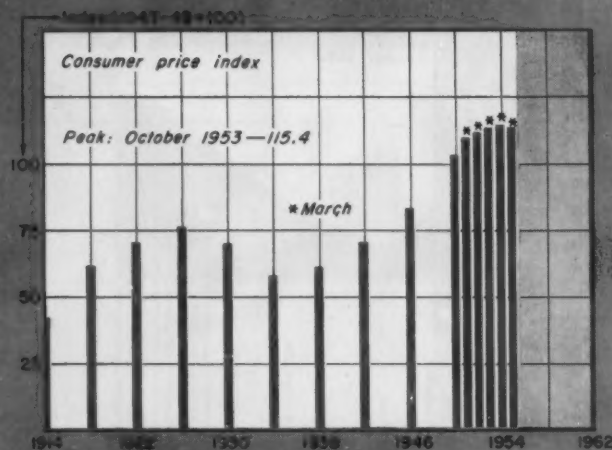
CHART VIII - CONSUMER INSTALLMENT CREDIT IS RISING



Source: Federal Reserve Board

... May be creating a credit crisis, while ...

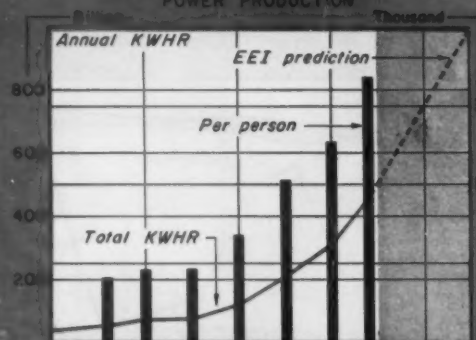
CHART VIII - COST-OF-LIVING HAS INCREASED SLOWLY



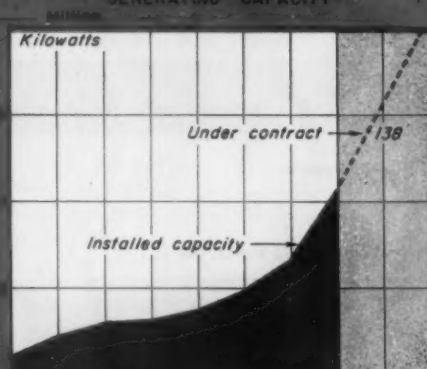
Source: BLS—Dept. of Labor

... The cost-of-living is stabilizing.

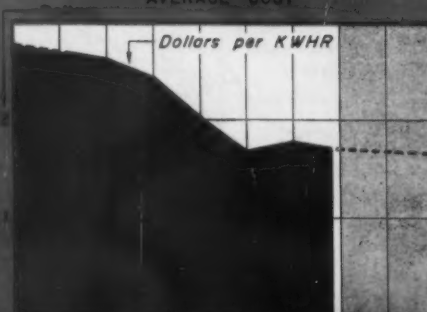
CHART IX - GROWTH OF ELECTRIC POWER
POWER PRODUCTION



GENERATING CAPACITY



AVERAGE COST



Source: Edison Electric Institute

ment of the electrical industry, but its growth rate is fairly typical of the industry as a whole.

Chart IX shows three aspects of electric power growth—generating capacity, power output, and cost. Generating capacity has approximately doubled every ten years. Capacity by the end of this year is scheduled at 116 million kilowatts, and by the end of 1958, according to Office of Defense Mobilization's goal, it will reach 150 million kilowatts. Electrical industry officials are now predicting a total installed capacity of 200 million kilowatts, or more, by 1965.

The electric power industry in the U.S., now producing 42.5% of the world's annual output of a trillion kilowatt hours, has its sights set on an annual output of a trillion kilowatt hours in this country alone by 1965. With a current weekly production of nearly 11-billion kilowatt hours, after having broken the 10-billion kwhr rate only in January of this year, current production is topping year-ago output by nearly 20%. This is an annual per capita output of more than 3400 kwhr. Yet the average cost of this power has decreased consistently to its present low rate of about 1.76 cents per kwhr.

An increasing world population is demanding more and more energy. Also, the per capita use of energy is increasing. The electrical industry thus faces one of the greatest markets in existence today.

ELECTRICITY OUTPUT SOARS while generating capacity is about doubled every ten years, and unit costs continue downward.

Building Construction

Current outlays for new building construction, in dollar volume, are at the highest rate in history—about \$42 billion a year, or 11% of the total economy. Maintenance and repair adds approximately another \$15 billion (Chart X). Considered a good business barometer, construction dollar volume, in current dollars, has increased for nine consecutive years in a row, including the "readjustment" year of 1954. Measured in 1954 dollars, and adjusted for population changes, the resulting volume is less spectacular. On this basis, 1953 showed a decline.

Capital expenditures, for new plants and equipment, have remained high (Chart XI), and are at an all-time peak this year.

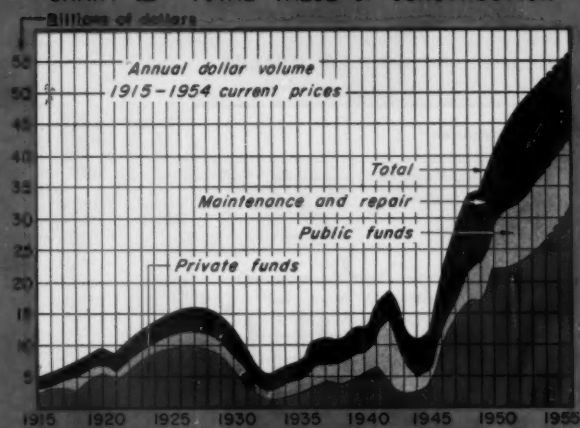
Home building accounts for about one-third of the total construction dollar volume and will during 1955 (Charts XII and XIII) set a new record for dollar volume. It is expected that housing starts will total about 1.3 million units, exceeded only by 1950's 1.4 million units. Because of the rate of expansion of consumer credit in the housing field, FHA and VA have tightened up credit terms for housing, which may slow down spending in this field slightly.

The existing backlog of new building construction (Table I) is now \$85 billion, according to *Engineering News-Record*, not including residential building. In another survey of building needs, the Departments of Commerce and Labor found requirements for public works construction (Table II), total \$204 billion over the next ten years, or an annual rate of \$20.4 billion, which is about 2.4 times the 1954 annual rate for this type of work. This huge public works construction backlog will continue to support the current building boom for some time to come, and to boost the expanding market for electric power and electrical goods of all types.

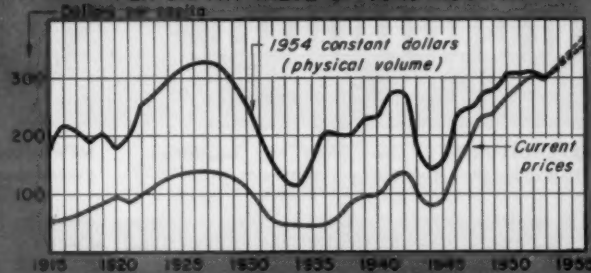
Electrical Construction Work

Electrical construction work, including maintenance and repair, will total nearly \$3.3 billion this year, it is indicated by preliminary estimates of this magazine (Chart XIV), a new record for this industry. Its growth rate is slightly ahead of the record boom rate for new building construction. This work is being done by something in excess of 18 thousand (Table III) electrical contracting firms (latest OASI figures are for 1st Quarter 1953), employing, in 1955, over 170,000 employees (Chart XV), with

CHART X—TOTAL VALUE OF CONSTRUCTION



PER CAPITA VALUE OF CONSTRUCTION



Source: Dept. of Commerce and Labor

NEW BUILDING CONSTRUCTION dollar volume skyrockets (top), while total and "per capita" physical volume hits new record.

TABLE I—BACKLOG OF NEW BUILDING CONSTRUCTION

(As of June 30, 1955)

Public Works Projects		Backlog (Thousand Dollars)
Type Work		
Waterworks		\$ 1,781,615
Sewerage		2,953,761
Bridges		2,677,378
Earthwork, irrigation		9,424,861
Streets and roads		10,748,228
Buildings		15,711,780
Unclassified		6,580,662
Total		\$49,878,285
Federal Government work		\$11,993,054
Private Projects		\$ 79,639
Bridges		12,447,169
Industrial buildings		14,212,963
Commercial buildings		8,475,475
Unclassified		
Total		\$35,215,248
Construction		\$35,215,248
Private		49,878,285
Public		\$85,093,533
Total		

Source: Engineering News-Record.

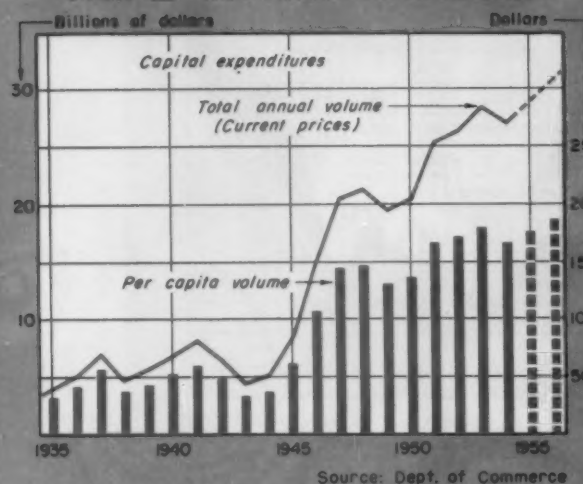
TABLE II—PUBLIC WORKS CONSTRUCTION REQUIREMENTS

(Needed During Next Ten Years)*

Type of Construction	Value of New Construction (in millions of 1954 dollars)		
	Needed 1955-64		
	Total	Annual Average	1954 Total
All types	204,000	20,400	8,636
Highways	92,000	9,200	3,458
Educational buildings	41,500	4,150	2,616
Hospital and institutional buildings	22,000	2,200	653
Water and sewerage works	25,300	2,530	1,029
Other non-Federal public works	23,200	2,320	880

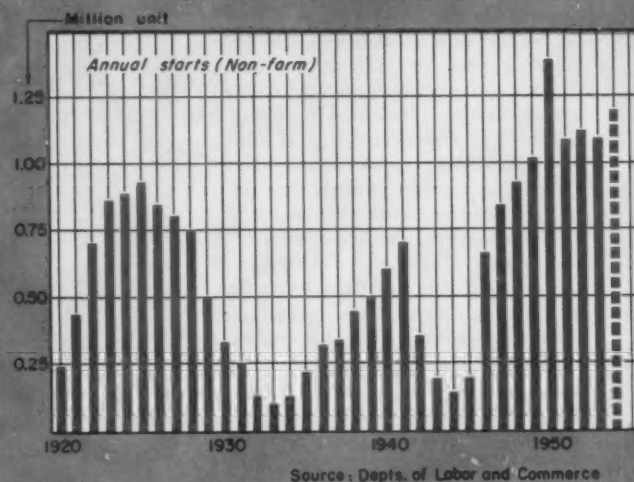
*Department of Commerce Estimate.

CHART XI - NEW PLANT AND EQUIPMENT



CAPITAL EXPENDITURES for new plant and equipment helps support new building construction, continues to climb.

CHART XII - NEW HOUSING STARTS



NEW HOMES being built this year total about 1.3 million, exceeded only by 1950's rate . . .

CHART XIII - ELECTRICAL CONSTRUCTION WORK

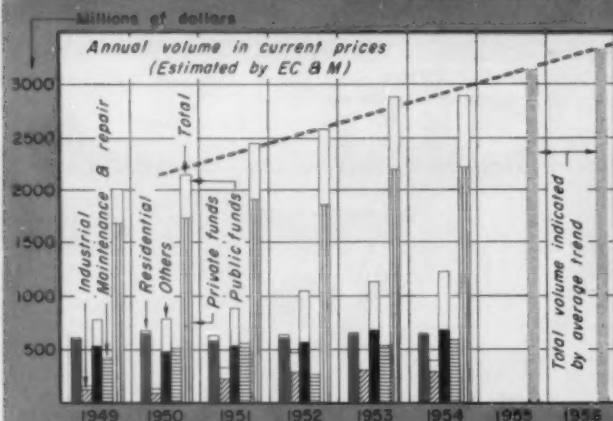
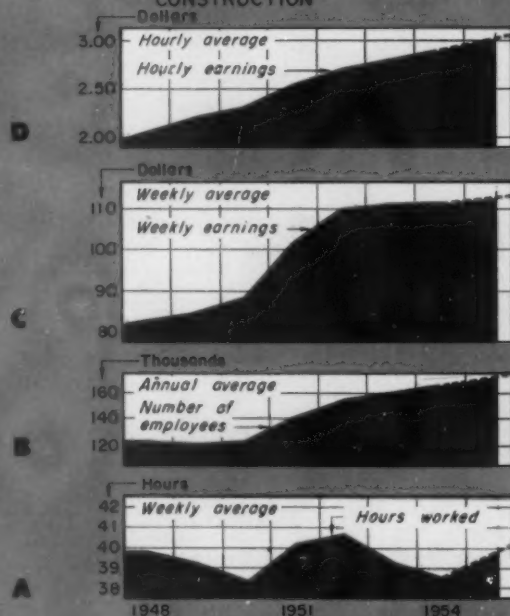


CHART XIV - ELECTRICAL WORKERS IN BUILDING CONSTRUCTION



RATE OF GROWTH for electrical construction work has averaged 7.2% per year since 1949, is climbing at a steady pace.

an estimated payroll of about \$215 million. Average hourly earnings of electrical workers have increased from \$2.08 in 1948 to an estimated \$3.00 at present, or nearly 50% in seven years. Total dollar volume of electrical construction work (Chart XV), for comparison, has increased even more, or about 58%.

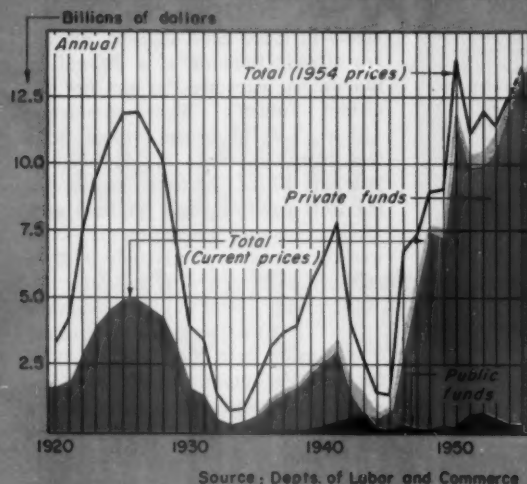
Electrical Equipment Sales

The electric lamp bulb, invented by Thomas A. Edison 76 years ago, may be considered the forerunner of today's electrical industry. About 30% of all electric energy goes into lighting today. Sales of incandescent and fluorescent lamps for general lighting purposes, excluding miniature, Christmas tree, automotive, and photographic lamp bulbs, are now in excess of \$400 million annually (Chart XVII). Dollar volume has more than doubled in the postwar nine-year period, and industry spokesmen are predicting a \$750 million annual volume by 1965.

Lighting equipment sales are expected to total \$400 million this year (Chart XVI), for a dollar volume slightly under annual lamp sales volume. Lighting equipment sales are expected to pick up rapidly from now on, under the impetus and activation

ELECTRICAL WORKERS have increased by 35% since 1948, and average hourly earnings have climbed 40% during the same period.

CHART XIII - NEW HOUSING DOLLAR VOLUME



... While dollar volume soars to annual rate of \$13.7-billion, to match the 1950 record.

of two lighting industry programs. One is the Certified Lighting Program of NEMA's Commercial and Industrial Lighting Equipment Section, now in active status in eight major metropolitan areas, and under consideration in many others. The other is an advertising and promotion program covering residential lighting, being sponsored by American Home Lighting Institute, trade association for the major residential lighting equipment manufacturers.

Sales of heavy electrical machinery and electrical construction equipment and supplies, are increasing, and have been growing at an annual rate of about 8% (Table IV) per year. This business has reached an approximate \$7.5-billion volume annual rate, and is nearly as large as the fast-growing electrical-electronic industry covering radio, TV, phonograph, defense, industry, distribution, broadcasting, and service and repair, which *Electronics*, a McGraw-Hill publication, reports is currently at a \$9-billion annual volume rate, with predicted expansion to \$20 billion by 1964.

Metals

The electrical industry is a big consumer of the three primary metals—steel, aluminum, and copper. The three industries producing these metals are also important factors in the national economy, especially steel, and hence their growth is also significant.

CHART XVI - TOTAL LIGHTING EQUIPMENT SALES

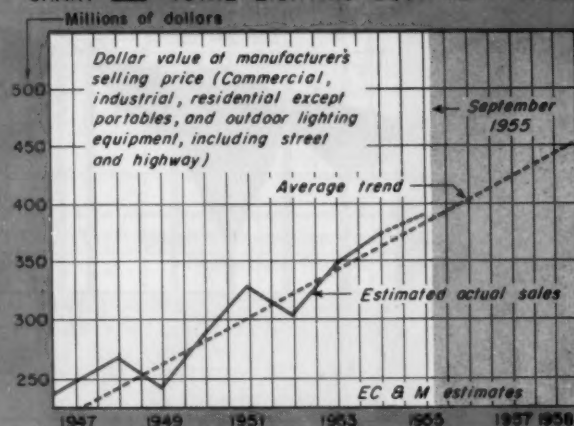


CHART XVII - ELECTRIC LAMP PRODUCTION AND SALES

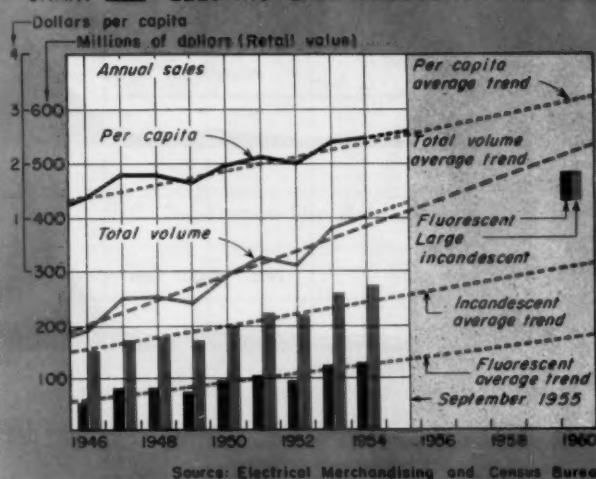


TABLE III—ELECTRICAL CONTRACTORS AND EMPLOYEES

(1st Quarter, 1953—OASI)*

Number of employees (mid-March)	151,582
Taxable payrolls (Jan-March)	\$181,264,000
Total reporting units	18,032
No. reporting units, by employee-size class:	
0-3	10,142
4-7	3,954
8-19	2,532
20-49	953
50-99	297
100 & over	154

*Bureau of Old Age and Survivors Insurance.
Source: Dept. of Commerce

TABLE IV—ELECTRICAL EQUIPMENT SALES

(Value in Millions of Dollars)

Products	1947	1951	1953	1953
Wiring devices and supplies	376	608	557	569
Motors and generators	856	1,210	1,308	1,432
Transformers	327	524	582	637
Industrial apparatus	113	161	190	194
Insulated wire and cable	895	1,097	1,266	1,310
Electrical appliances*	551	721	657	782
Total	3,118	4,321	4,560	5,024

*Does not include radios, TVs, phonographs, etc.
Source: Census Bureau and Dept. of Commerce

CHART XVIII — STEEL CAPACITY AND PRODUCTION

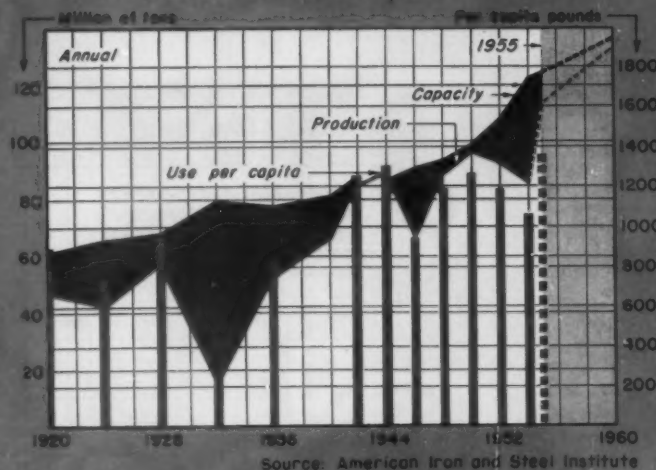


CHART XIX — OUTPUT OF PRIMARY ALUMINUM

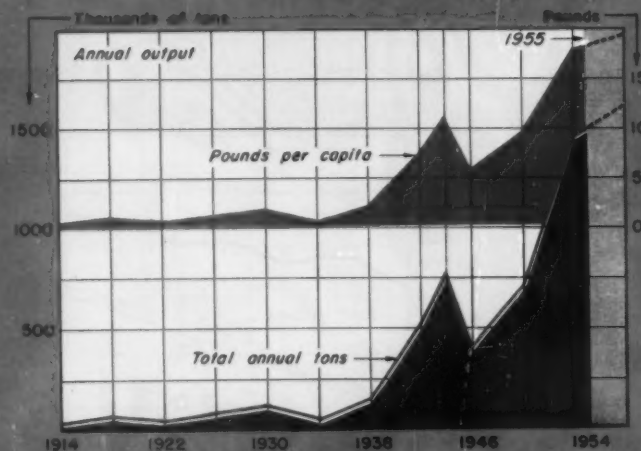
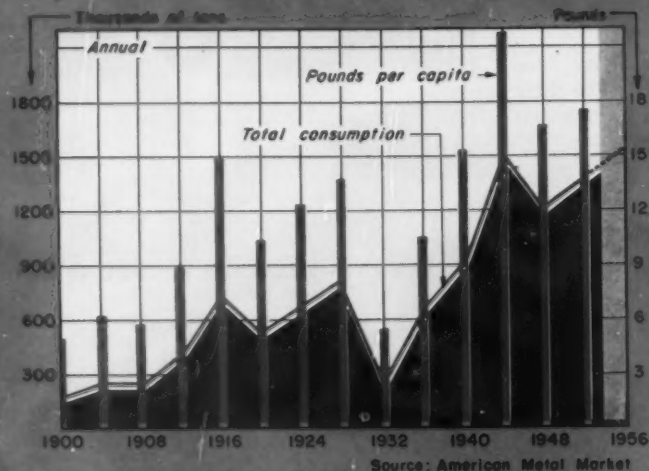


CHART XX — COPPER CONSUMPTION IN U.S.



Steel mill producing capacity has been expanded by 54% in the past 15 years, to 125.8 million tons annually in 1955. Steel industry officials are already thinking of a 200-million ton annual capacity "in the not too distant future". Steel production (Chart XVIII) broke through to a new monthly record in May of this year, of 10,331,000 tons, beating the previous monthly high set in March 1953. Current production is at a weekly rate of approximately 95% of capacity, with a growing backlog.

Increasing demand for aluminum (Chart XIX) has forced a third round of expansion, now under way. In 1950, the nation's output was 800,000 tons, when the government sponsored a 446,000-ton expansion for 1951; and a 231,000-ton expansion for 1952. Currently, the big three of aluminum—Alcoa, Reynolds, and Kaiser—are adding another combined 290,000 tons per year. Other firms not now in the aluminum field are also making plans to enter. The growing power of the 1955 boom is generating the enormous demand for aluminum, plus decreased production and rising prices of copper, due to strikes in the U. S. copper mines during 1955 and growing world demand for the red metal.

Copper consumption reached a per capita high (Chart XX) of 21.7 pounds annually during World War II, has since dropped some 25% and then increased slowly again. Copper demand has held consistently, but domestic producers have been unable to supply the demand with its normal output due to labor troubles. Copper is expected to remain scarce for some time, even though most strikes have now been settled. Copper and brass fabricating firms have been forced to curtail operations during the summer months because of copper shortages stemming from the strikes. Copper costs have increased during the past few months from 30 to 36 cents per pound, and recently rose to 43 cents per pound. Actually most fabricators reportedly are currently paying premiums of up to 15 cents a pound and still are unable to get enough copper to meet their requirements.

This copper shortage is slowing production of many wire and cable producers, and manufacturers of electrical equipment using copper. The shortage, plus higher costs, is expected to hasten considerable conversion to aluminum, especially as capacity expansion for aluminum is completed, and the lighter metal becomes more generally available.

CHECKING WOUND-ROTOR INDUCTION MOTOR

By **Walter J. Prise**, Chief Engineer,
Queens Electric Motors, Inc., Jamaica, N. Y.

A WOUND-ROTOR induction motor, as its name indicates, has coils of wire wound on its rotor. This rotor is unlike the squirrel-cage rotor which is made up of bars between end rings. The windings on a wound rotor are connected to collector rings on the rotor shaft. By means of these collector rings, external resistance can be cut in and out of the rotor circuit to vary torque and speed of the motor. Fig. 1 shows the circuits of a wound-rotor induction motor.

Torque of a wound-rotor induction motor is proportional to magnetic flux, armature current and the cosine of the space angle between flux and the current. Flux of the motor, however, is practically constant since the back e.m.f. is practically constant. Usually, armature reactance is small in comparison to its resistance. As a result, armature impedance is resistance. If the slip remains constant, induced e.m.f. of the rotor does not change.

If resistance is introduced into the rotor circuit, the armature current, which is equal to e.m.f. of rotor divided by rotor impedance, decreases. Then since cosine "a" does not increase as rapidly as the armature decreases, the torque must decrease.

To bring the torque back to its original value, the armature current must be increased. For the armature current to increase, the rotor induced e.m.f. must increase. Since flux is constant, the increase in induced e.m.f. may be obtained only if the flux is cutting rotor conductors at a

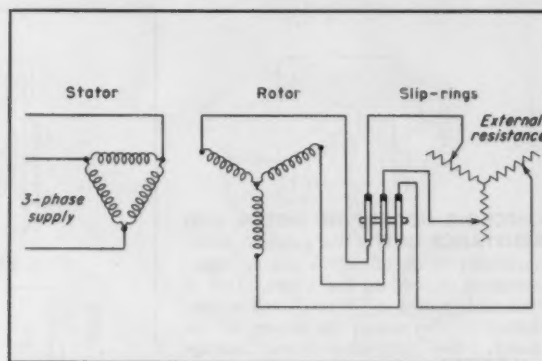


FIG. 1—Typical Connection for Wound-Rotor Induction Motor

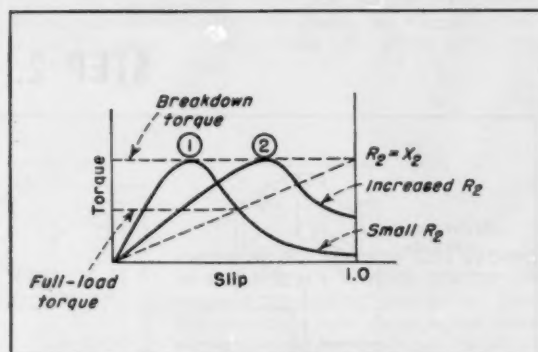


FIG. 2—Torque-Slip Relationship

greater rate. For a given value of torque, therefore, the slip must increase when resistance is introduced into the rotor circuit. The torque-slip relationship will change as shown in Fig. 2 (curve 1 to 2). Full-load torque is obtained at increased value of slip, as the rotor resistance is increased. The value of maximum torque will not be affected, but the point of maximum torque moves to the point of a greater value of slip. The rotor then runs at reduced speed, with a loss in efficiency due to increased I^2R losses.

Control of speed may also be obtained by the introduction of resistance into the rotor circuit. This is similar to the armature-resistance method of speed control in the dc motor. Reduction of speed is accompanied by loss of efficiency and by poor speed-regulation.

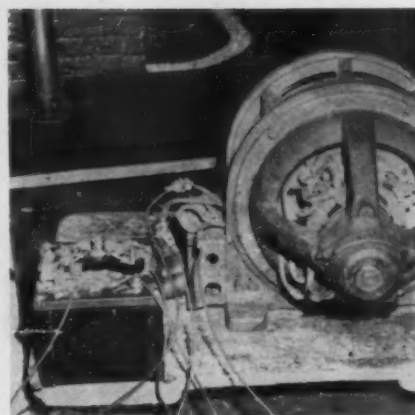
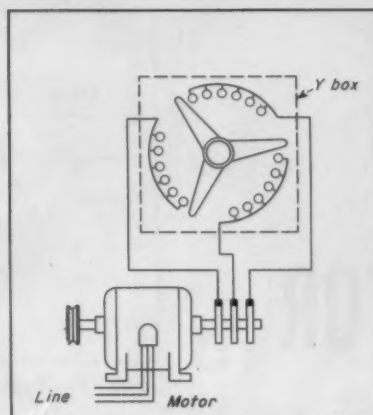
Electrical efficiency of the rotor is equal to the ratio of actual motor speed to synchronous motor speed. For example, at 25% slip, the rotor is 75% efficient, i.e., 25% is lost as heat in the rotor resistance.

Breakdown torque may be obtained at starting. To obtain this condition, rotor resistance per phase (R_2) should be approximately equal to rotor reactance per phase at standstill (X_2).

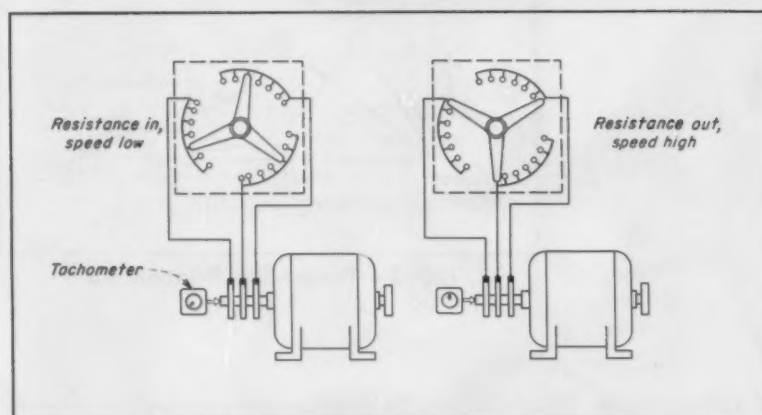
The following are tests for wound-rotor induction motors. Some are for use in trouble-shooting at the place where the motor is installed; others are for use after repair or rewinding.

STEP 1.

CHECKING HOOKUP OF MOTOR AND RESISTANCE UNIT. The external resistance unit is contained in a box shown alongside motor in the photo. This is commonly called a "Y box" and is connected in the circuit as shown in the sketch. The secondary (rotor) voltage without any external resistance in the circuit can be measured with a voltmeter across two of the slip rings.



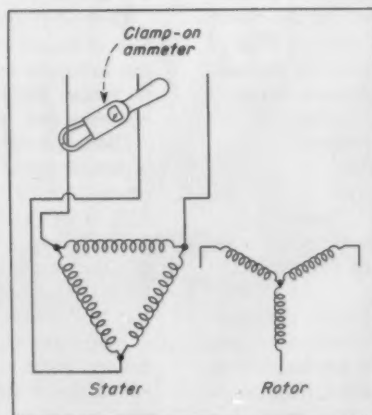
STEP 2.



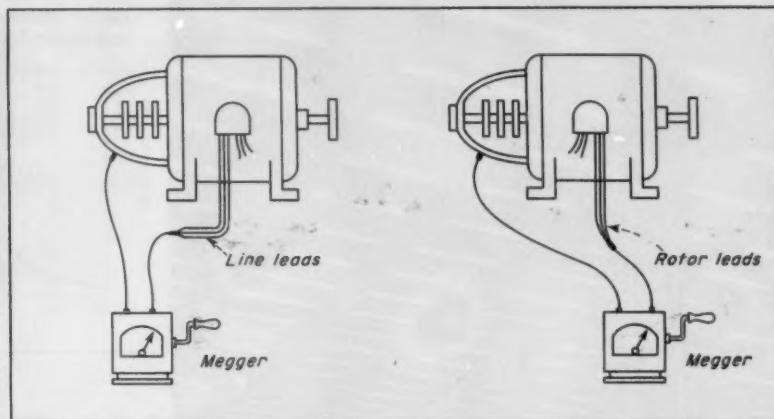
CHECKING SPEED OF THE MOTOR FOR VARIOUS VALUES OF EXTERNAL RESISTANCE IN THE SECONDARY CIRCUIT. In this step, a tachometer is used to measure the speed of motor rotation. As resistance is added in the secondary circuit the motor speed decreases. Speed can be checked for changing secondary resistance.

STEP 3.

CHECKING FOR BALANCE OF CURRENT FLOW IN EACH LEG OF MOTOR. In this test, a clamp-on type ammeter is used to measure the current flow in each of the incoming supply lines. Currents should be balanced. This check will often reveal defects in the windings.

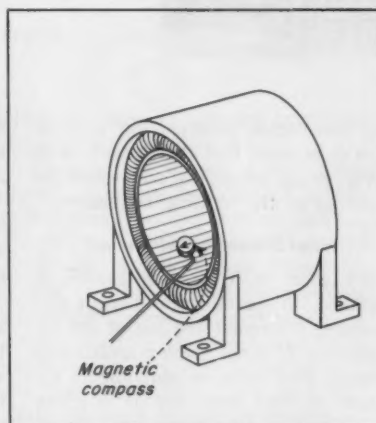
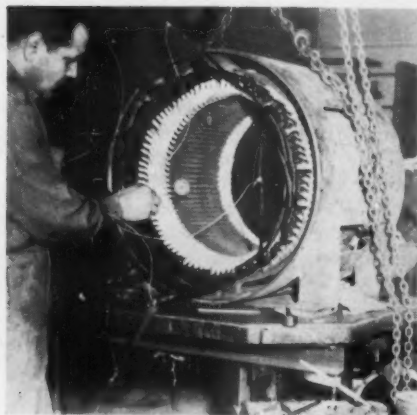


STEP 4.



CHECKING FOR GROUND FAULTS IN STATOR AND ROTOR CIRCUITS. To test the stator circuit, the Megger is connected between the line leads (connected together) and the motor frame. To test for grounds in the rotor circuit, the Megger probes are connected between the rotor leads and the frame. These two checks are shown in the sketches. The photo shows the Megger being cranked—as it is used to test for grounds in either the stator or rotor circuit.

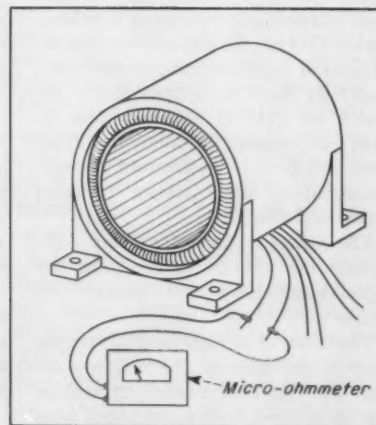
STEP 5.



CHECKING POLARITY OF COIL GROUPS IN COMPLETELY WOUND STATOR.

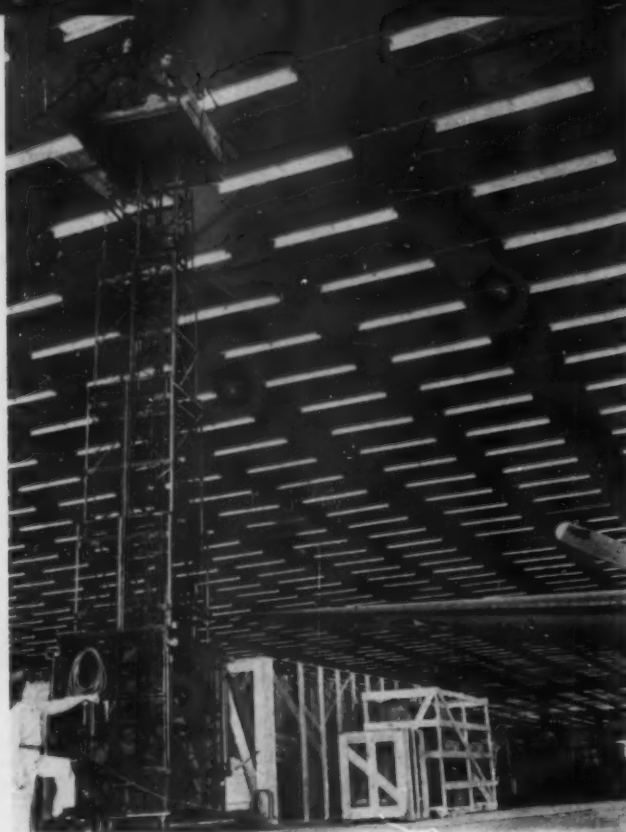
A magnetic compass is used in this test. The compass is held (shown in the photo with a wire rod handle) inside the stator and moved slowly around the inside surface of the stator. The leads are energized with dc current and connected temporarily for the required number of poles. Then, depending upon the number of poles, the compass needle should reverse its direction as it is moved around the stator. Each time the compass passes from one pole to the next, the needle direction should reverse 180°. This test will indicate incorrect connection of leads before final hookup is made.

STEP 6.



CHECKING COILS, GROUPS AND PHASES FOR WRONG GROUPING OR WRONG CONNECTIONS.

In this test, a micro-ohmmeter is used to check resistance of individual coils, groups of coils and all coils of a phase. Deviation from expected values may mean wrong grouping or wrong connections. After this test, the rotor and stator should be tested with a growler to disclose any possible shorts. Ground tests, dielectric test and high voltage tests should also be given as specified in motor testing standards.



LIGHTING MAINTENANCE schedules are necessary to maintain illumination levels at design standards, and lamp replacement and luminaire cleaning costs can be substantial as in this aircraft plant where movable towers facilitate both operations.

ECONOMICS

By **M. E. Haskins, Jr.**

*Westinghouse Lamp Division,
Bloomfield, N. J.*

LIGHTING maintenance has many aspects, but generally, the basic questions are: Does it pay to replace entire groups of old lamps which still have some lamp-life remaining, or is it more economical to replace them individually, as burn-outs occur? And, is it really a saving, in cold cash, to clean lamps and luminaires regularly, on some periodic time interval basis? If the answer to these is "yes", (that money can be saved by group relamping, and by cleaning lamps and luminaires regularly), then how can it be determined what interval between such maintenance operations will prove most economical?

These questions are considered here as simply as possible, strictly on a dollars and cents basis, so that conclusions may be used reliably as a guide for planning and executing a lighting maintenance program. In order to do this, it is necessary to disregard those factors which are peculiar to certain installations, and whose effects on maintenance costs vary so much between installations that it is impractical to present "average" figures for each. Some of the more important factors are given in Table I. All can affect the economics of relamping and luminaire cleaning, and should therefore be considered individually as they apply specifically to

the installation involved. In general, it will be seen that their result is to favor group relamping and scheduled cleaning of the lighting equipment.

What System for Relamping?

As soon as a lighting system is installed, its operating costs begin, and continue throughout the life of the installation. If lamps are not replaced as groups, they must be individually replaced as they burn out. It is going to cost money, by either method. However, when the cost of relamping individually is greater than the cost for group relamping, money is wasted if lamps are not replaced as a group.

The total cost of individual, or random, relamping is the sum of four basic costs: 1) Cost of replacement lamps; 2) Cost of replacement labor and overhead; 3) Cost of wasted power for which no light is obtained; and 4) Cost of wasted installation. These costs can each be determined through computation, using simple formulas given in Table II.

The cost of replacement lamps is obviously the product of net price per replacement lamp and quantity of lamps.

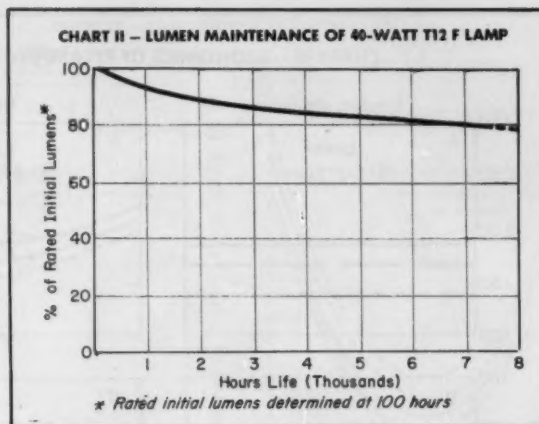
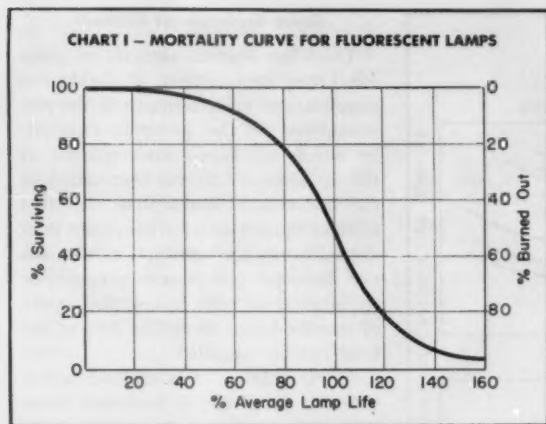
The cost of replacement labor per lamp is the wage of the maintenance man for the time needed to replace one lamp. Overhead is neglected here

because of the difficulty of arriving at average values which are broadly applicable to typical installations. However, such costs can and should be included in the hourly wage figure as they relate to the installation under consideration.

The cost of wasted power per lamp is proportional to its depreciation in lumen output. As a lamp burns over a period of time, it gives less and less light per watt. Since its power consumption in watts remains practically unchanged, it results that each lumen of light costs more, and that power that is actually paid for is wasted (Chart II).

The approximate cost of the wasted installation refers to the extra initial investment necessary, if lamps are used without planned replacement or scheduled cleaning. To achieve average level of illumination the initial level must be higher, if lamps are not to be properly maintained. This high initial level can be achieved only by installing extra lighting equipment and related wiring and installation, with resulting higher initial and amortization costs. The effects of this factor is not included herein, so that the results may apply to existing installations where initial and amortization costs are already established and fixed.

Total random relamping costs, as



OF LIGHTING MAINTENANCE

These basic formulas will indicate most economical method of lamp replacement—random, or group—and most economical time interval between cleaning periods.

outlined above, are thus the sum of the costs for replacement lamps, replacement labor (and overhead), and wasted power, all of which may be accurately determined by formulas (Table II).

Correspondingly, the total cost of group relamping is the sum of four component costs: 1) Cost of replacement lamps; 2) Cost of replacement labor and overhead; 3) Cost of wasted power; and 4) Cost of random replacements of burnouts between group relamping times. These component costs may also be computed by formulas (Table II), similarly to the procedure used for computing random relamping costs.

In computing the *cost of replacement lamps* for group relamping, rated lamp life and hours lamps are to be burned before replacement must also be considered, as well as the cost of lamp replacements for burn-outs occurring before group replacement time. The number of burn-outs to expect can be determined from Chart I. Their cost is obtained from the formula used for "cost of replacement lamps" for random relamping, where N equals "number of lamp burn-outs".

Cost of replacement labor for group relamping also requires that rated lamp life and hours lamps are to be burned before replacement be con-

sidered. Overhead costs are neglected, as previously explained.

The *cost of wasted power* when group relamping is practiced is obtained exactly as was done for random relamping. The formula, though approximate, favors random relamping.

The *cost of burn-out replacements* occurring between group relamping cycles, covering lamp costs and labor replacement costs, may be included in the first two factors above, or calculated separately, using the random replacement formulas and "number of burn-outs" as "number of lamps".

The overall cost for group relamping is obviously the sum of these component costs.

A typical lighting installation, consisting of 100 40-watt fluorescent lamps, is given as a case study in Table III. As can be seen by study of this example, in which the various conditions are assumed, it is an easy matter to apply the various formulas, and to arrive at a "dollars and cents" evaluation for both random relamping and group relamping.

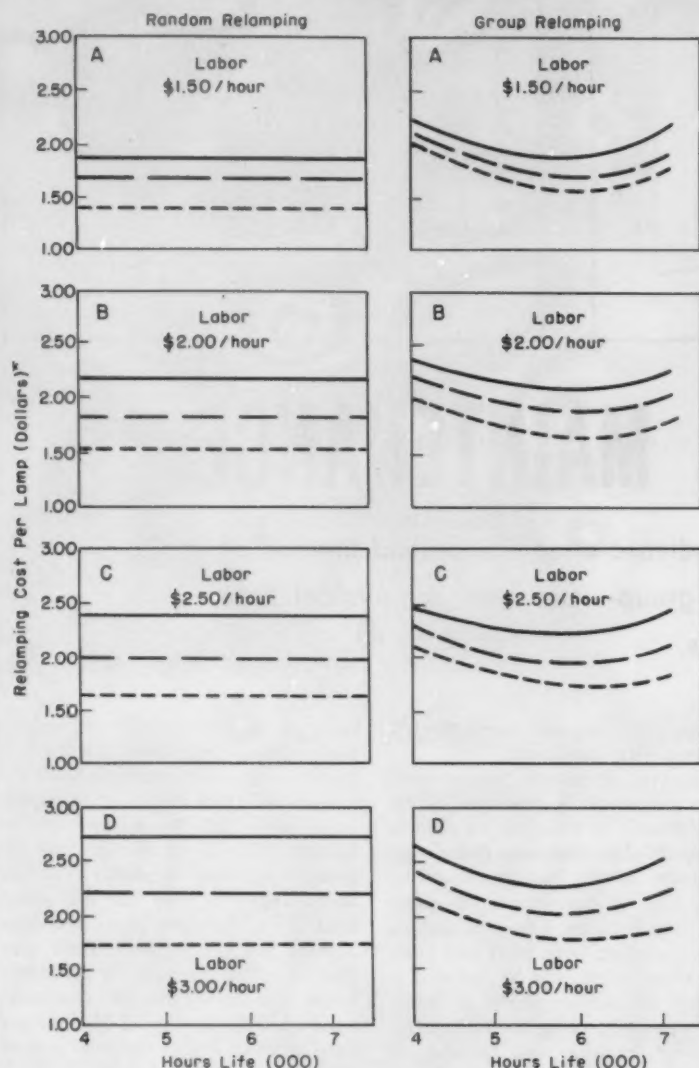
In this case study, group relamping is figured based on relamping after 5000 hours of burning. Total costs for group relamping on this basis is \$208.85. Similar calculations, with group relamping performed after 6000 hours and 7000 hours, result in total

costs of \$203.75 and \$219.80, respectively. Other calculations, based on relamping after 5500 hours, indicate the lowest total costs for group relamping occur near this point, and are at \$203.41. Thus the minimum costs for group relamping evidently fall between 5500 and 6000 hours at about \$203. This, therefore, gives a savings of over \$14 per hundred lamps over random relamping costs for the installation considered and the conditions assumed. This savings of 14 cents per lamp is about 7% of the total cost of relamping.

Chart III shows curves of relative costs of random and group relamping, for various labor costs and times (minutes) for relamping. The curves of the B chart represent the case study given in Table III. It can be seen from these curves that group relamping does not always pay, especially when the labor rate is low and/or the time required for random relamping is ten minutes or less, as would be the case in small shops and stores. However, it should be kept in mind that the conditions shown in Chart III were purposely selected to show random relamping most favorably.

If higher power rates or a greater ratio of "random relamping time" to "group relamping time" (R/G) were used, the results would show group re-

CHART III — ECONOMICS OF RELAMPING



*Includes cost of lamp and 1¢ per KWH power rate

- 30 minutes random relamping time per lamp.
— 6 minutes group relamping time per lamp.
- - - 20 minutes random relamping time per lamp.
- - - 4 minutes group relamping time per lamp.
- ... 10 minutes random relamping time per lamp.
... 2 minutes group relamping time per lamp.

lamping to be economical in even more cases. For example, refer to Chart IV. The comparison of random and group relamping costs for a 20-minute random relamping time per lamp shows that with the power rate at one cent per KWH and a ratio of $R/G = 5$, it is uneconomical to have group relamping. However, when the cost of power goes to 2.55 cents per KWH, or $R/G = 6$, it becomes profitable to in-

stitute a group relamping system at about 5750 burning hours.

Generally, the data seem to show that if the cost of random relamping, including cost of lamp, is more than twice the cost of the lamp alone, it pays to employ group relamping. The most economical period for group relamping can generally be expected at slightly less than 600 burning hours, as indicated by the case study.

Group Replacement Methods

There are several methods or plans for group replacement. Probably the simplest and most common is the one considered in the previous example, in which all lamps are replaced at the economical interval best suited to the individual installation. In this method enough standby lamps are purchased to replace burn-outs as they occur between group relampings. For an interval of 6000 hours, the supply of standby lamps should be 20% of the total number installed.

A variation of this method which grows in popularity is to replace burn-outs as they occur between group relampings but with lamps chosen from the group previously replaced, on a basis of best appearance and least end-blackening. The calculations for this method are the same as in the example above, except that the item, cost of lamps for random relamping, is not included. Thus, calculations will show this to be a more economical way of relamping. However, it is questionable that the entire calculated saving can be realized since the cost of labor required for special handling, marking, and storing the "special" lamps and their lower life expectancy will decrease their value. In installations where conventional group relamping does not show an appreciable advantage over random relamping, this method may prove worthwhile.

A third method that achieves economy in burn-out replacement simply neglects to replace these burn-outs at all. In this method the analysis does not include "cost of lamps" and "cost of labor to random relamp". Obviously, still greater dollar and cents savings result. However, these "savings" are at the expense of light. This method requires that the original installation include more lamps and equipment to provide the same level of illumination available from a properly maintained system. This of course results in higher initial, operating, and amortization costs. If it is argued that the decreased level of illumination may be adequate, then it should be urged that fewer lamps and fixtures be used and that they be properly maintained. An outstanding point is that such mathematics for group replacement plan can be misleading if all pertinent factors are not considered.

Additionally, when series ballasts are used, it is highly impractical to economize by permitting outages to continue until group replacement is made. With series ballasts, the failure

of one lamp causes the remaining lamp to be extinguished entirely or to operate at about 25 percent light output. Consequently, for each outage, random relamping is necessary and very costly since all lamps in a luminaire must be tested to identify the faulty lamp. For installations employing series ballasts, group relamping will prove more economical than would be the case for lead-lag ballasts. Often the optimum economic replacement interval is about 5500 hours.

Once a method for group replacement has been selected as the best for a particular installation and time interval, the stock of lamps for burn-out replacement provides a practical method for scheduling replacement operations. When stock is set aside for burn-out replacement in a quantity determined by the life expectancy curve of Chart I, group replacement should take place when this stock is exhausted. When no provision is made for replacement of burn-outs, it is necessary, of course, to maintain a log of burning hours to indicate the proper time for relamping.

Economics of Cleaning

If luminaires are not cleaned, light is lost in absorption by the dirty surfaces of lamps and reflectors. This results in lower levels of illumination and therefore a part of the power cost is incurred for light that never reaches the work plane. Likewise, lamps and luminaires represent an investment, a part of which is wasted whenever the equipment is inefficient. There are the obvious considerations which determine the cost of dirty, light-absorbing equipment.

The cost of cleaning is easily calculated as the total cost of cleaning material and labor. It can vary from as little as five cents per luminaire to as much as a dollar or more.

The cost of dirty luminaires and lamps is slightly more difficult to determine. The best method seems to be to express this cost in terms of the "cost of waste"—wasted power, wasted lamps, and wasted luminaires and wiring. This waste can be expressed by formulas, as given in Table IV.

By using these "cost of waste" formulas it is an easy matter to calculate for the length of time for cleaning interval, designated as "T" in the formula, and expressed in "months". A typical case study is calculated in Table V, in which the assumed conditions give 6.4 months as the economic

CHART IV — CASE STUDY IN RELAMPING COSTS

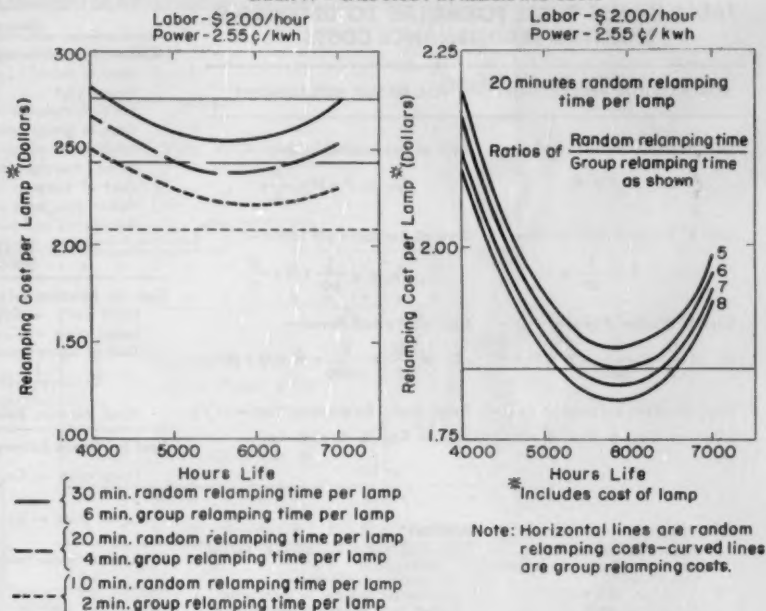


CHART V — ECONOMIC CLEANING INTERVALS

(For various cleaning costs of two-lamp fluorescent luminaires)

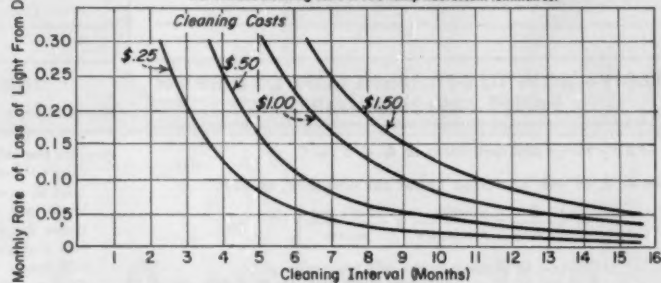


TABLE I—FACTORS WITH FRINGE EFFECTS ON LIGHTING MAINTENANCE

1. Cost of interruptions produced when employees must report lamp outages and process outage reports.
2. High initial cost of installing a lighting system with excess capacity to insure proper illumination when system is not properly maintained.
3. Reduced cost of maintaining auxiliary equipment (ballasts, starters, etc.) when burned-out lamps are replaced promptly.
4. Reduced accident rate resulting from proper maintenance of the lighting system.
5. Effect of adequate lighting in decreasing defects in workmanship and spoilage.
6. Improved worker morale and efficiency resulting from adequate lighting.
7. Maintaining attractive appearance in areas where customers and visitors would notice faulty lamps and dirty luminaires.
8. Costs resulting from idle machines and idle workers while lamps are being changed and luminaires cleaned.
9. Reduced taxable inventory and lamp storage requirements when relamping is done on a scheduled basis.

TABLE II—USE THESE FORMULAS TO DETERMINE LIGHTING MAINTENANCE COSTS

FOR RANDOM REPLACEMENT	FOR GROUP REPLACEMENT
Cost of Replacement Lamps— $C_{RL} = P \times N$	Cost of Replacement Lamps— $C_{RG} = P \times N \times \frac{H}{B}$
Cost of Replacement Labor— $C_{LR} = R \times \frac{T}{60} \times N$	Cost of Replacement Labor— $C_{LG} = R \times \frac{T}{60} \times N \times \frac{H}{B}$
Cost of Wasted Power— $C_P = \frac{D}{2} \times \frac{K}{1000} \times W \times N \times H$	Cost of Wasted Power— $C_{PG} = \frac{D}{2} \times \frac{K}{1000} \times W \times N \times H \times \frac{H}{B}$
Total Random Relamping Cost— $C_{RO} = C_{RL} + C_{LR} + C_P$	Total Group Relamping Cost— $C_{GO} = C_{RG} + C_{LG} + C_{PG} + C_{RL} + C_{LR} + C_P$

WHERE:

D=Percentage decrease from initial light output at replacement time (Chart II)
K=Power rate (\$/KWH)
N=Number of lamps
H=Rated lamp life (Hours)
P=Net price per lamp (Dollars)
T=Time for one relamping (Minutes)
W=Rated power consumption (Watts/Lamp)

WHERE:

B=Hours lamps are burned, before replacement
H=Rated lamp life (Hours)
N=Number of lamps in installation
P=Net cost per lamp (Dollars)
R=Hourly wage rate (Dollars/Hour)
T=Time required per lamp (Minutes)
*This formula favors random replacement.

TABLE IV—HOW TO DETERMINE COST OF DIRT ON LAMPS AND LUMINAIRES

Cost of dirty lamps and luminaires = A + B + C

Where — A = cost of wasted power per luminaire, or

$$= \left\{ \frac{\$}{\text{KWH}} \times \frac{\text{watts}}{\text{luminaire}} \times \frac{\text{hours use}}{\text{month}} \right\} DT^2$$

B = cost of wasted lamps per luminaire, or

$$= \left\{ \frac{\$}{\text{lamp}} \times \frac{\text{no. of lamps}}{\text{luminaire}} \times \frac{\text{hours use}}{\text{month}} \times \frac{1}{\text{hours life}} \right\} DT^2$$

* Or, group relamping hours

C = cost of wasted luminaires and wiring per luminaire, or

$$= \left\{ \frac{\text{total cost of installation}}{\text{no. of luminaires}} \times \frac{1}{\text{amortization period (mos.)}} \right\} DT^2$$

And — T = Cleaning interval, in months

$$D = \% \text{ waste } \left\{ \frac{E_1 - E_2}{2E_1 M} \right\}$$

E_1 = footcandles before lamps and luminaires are cleaned

E_2 = footcandles after lamps and luminaires are cleaned

M = No. months elapsed from date of installation, or from date of last cleaning and relamping, to when readings E_1 and E_2 are taken (Readings E_1 and E_2 should be taken on the same day).

$$T^2 = \left\{ \frac{\text{cost of cleaning}}{\text{cost of installation per mo.} \times \text{rate of waste per mo.}} \right\}$$

cleaning intervals. Chart V shows how the economic cleaning interval varies with the monthly rate of loss of light produced by accumulation of dirt and with the cost of cleaning, while other factors are constant, as in the example in Table V.

In practice, it is often advantageous to use a longer or shorter cleaning interval than the one calculated, so that the cleaning schedule will coincide with the relamping schedule. Savings will result if luminaires are cleaned when lamps are replaced.

TABLE III—MAINTENANCE COSTS CASE STUDY

(Based on Use of Formulas in Table II)

Assume the Following Conditions:

Cost of labor	\$2.00 per hour
Power cost	1¢ per kw-h
Time to random relamp	30 min./lamp
Time to group relamp	.6 min./lamp
Number of lamps in system	100 40-watt F
Rated average lamp life	7500 hours
Cost of lamps	.80¢ each
Power per lamp (inc. ballasts)	50 watts
Relamping cost per lamp (at \$2.00/hr)—	
random relamping	\$1.00/lamp
group relamping	\$0.20/lamp

Cost for Random Relamping—

Lamp costs — $C_{RL} = \$0.80 \times 100$ \$80.00

Labor costs — $C_{LR} = \$1.00 \times 100$ 100.00

Cost of wasted power —

$$C_P = \frac{.20}{2} \times \frac{.01}{1000} \times 50 \times 100 \times 7500 \dots\dots\dots 37.50$$

Total Random Relamping Cost \$217.50

Cost for Group Relamping (at 5000 Hours)—

Lamp costs — $C_{RG} = \$0.80 \times 100 \times \frac{7500}{5000}$ \$120.00

Labor costs — $C_{LG} = \$0.20 \times 100 \times \frac{7500}{5000}$ 30.00

Burnout lamp costs — $C_{BR} = \$0.80 \times 10 \times \frac{7500}{5000}$ 12.00

Burnout labor costs — $C_{LB} = \$1.00 \times 10 \times \frac{7500}{5000}$ 15.00

Cost of wasted power —

$$C_P = \frac{.17}{2} \times \frac{.01}{1000} \times 50 \times 100 \times 500 \times \frac{7500}{5000} \dots\dots\dots 31.85$$

Total Group Relamping Cost \$208.85

TABLE V—COST OF DIRT CASE STUDY

(Based on Formulas in Table IV)

Assume the following conditions:

Cost of cleaning, per luminaire	\$0.50
Cost of power, per KWH	0.02
Watts per luminaire (2/40-w. F plus ballasts)	100
Hours burned per month	200
Net cost per lamp	0.80
No. lamps per luminaire	2
Cost of luminaires, wiring, and installation	\$6000
Total number of luminaires	100
Amortization period (10 years)	120 mo.
Group relamping interval (burning hours)	6000
E_1 —measured 2 months after installation	60 Ft-c
E_2 —measured 2 months after installation	62.5 Ft-c

Then, from formulas in Table IV—

$$D = \frac{62.5 - 60.0}{2 \times 62.5 \times 2} = .01 = \% \text{ waste}$$

$$A = \left\{ \frac{\$0.02}{1000} \times 100 \times 200 \right\} .01^2 = .004T^2$$

$$B = \left\{ \$0.80 \times 2 \times 200 \times \frac{1}{6000} \right\} .01^2 = .0032T^2$$

$$C = \left\{ \frac{\$6000}{100} \times \frac{1}{120} \right\} .01^2 = .005T^2$$

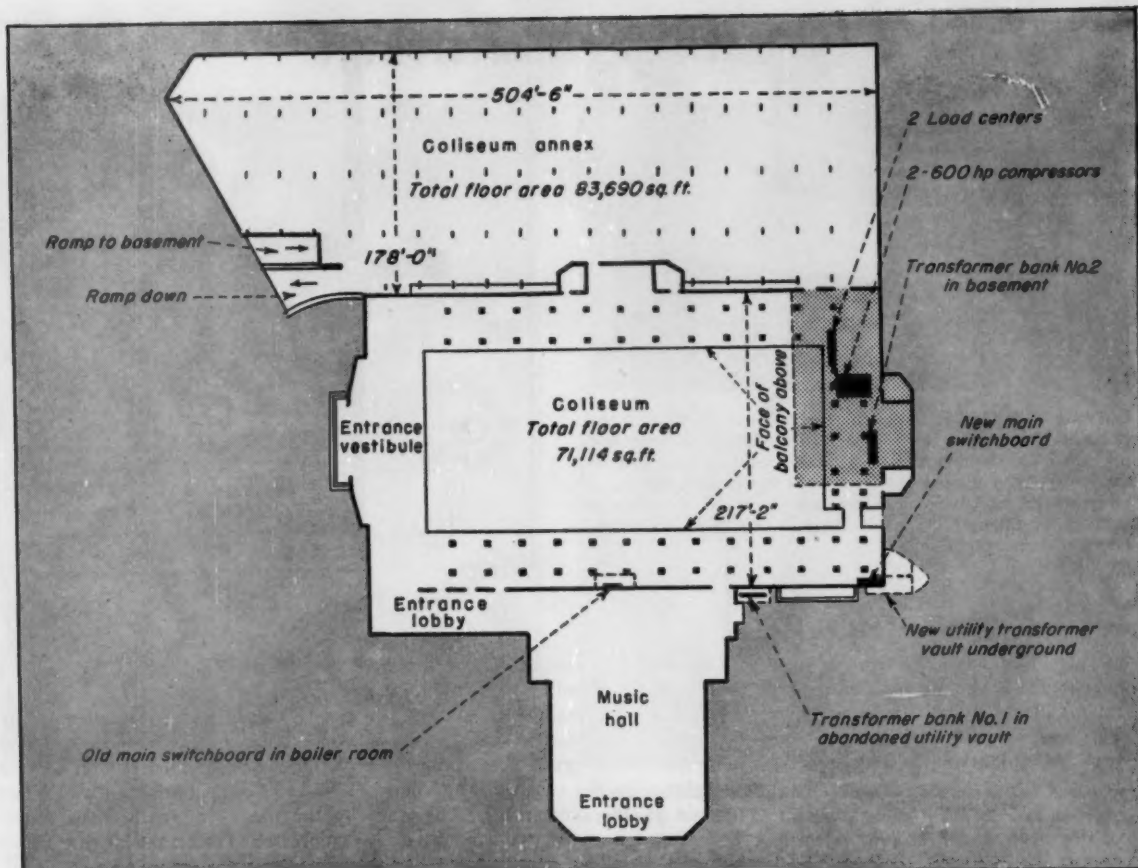
Thus:

$$T^2 = \left\{ \frac{\$0.50}{.004 \times .0032 \times .005} \right\} = \frac{.5}{.0122} = 41$$

And

$$T = \sqrt{41} = 6.4 \text{ months} = \text{economical cleaning interval}$$

With these suggestions, it should be possible to analyze the basic economics of relamping and cleaning for a particular installation so that a definite maintenance schedule can be put into effect with a quantitative basis for decision.



PLOT PLAN shows layout of major elements of distribution system.

Modernizing A Convention Hall

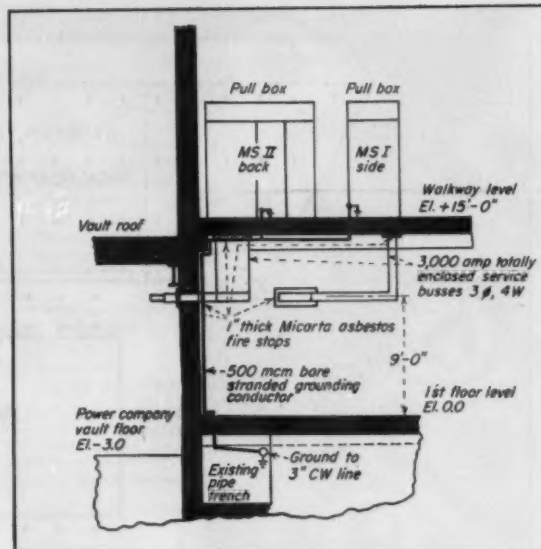
Extensive rewiring and installation of new equipment were part of the recent modernization of Sam Houston Coliseum, Houston, Texas, now the largest air-conditioned convention hall in the country. Dale S. Cooper and Robert J. Cummins, Associated Consulting Engineers, Houston, designed the electrical layout.

By Ernest R. Keeton, President,
Gulf Electric Co., Houston, Texas

"TEXAS-SIZE" modernization is one way to describe the electrical remodeling recently finished in the Sam Houston Coliseum, Houston, Texas. This large convention hall, scene of a great variety of events from stock shows to Billy Graham revivals, has been treated to a modern and extensive system of electrical distribution and utilization facilities. Now the largest air-conditioned convention hall in the country with 1200 tons of air conditioning capacity, the Coliseum boasts other additions such as: a new hung-ceiling of over two acres of fiberglas acoustical tiles; complete new lighting in the new ceiling; escalators to the balcony; and additional permanent seating capacity of 13,000. A study of the system design details and installation and construction methods



SERVICE BUS consists of totally enclosed copper bars, 3 per phase and a single neutral bar, carried through wall and up into main switchboard on walkway level above. One of two such incoming busways is shown here suspended by a channel-iron trapeze hanger on rods anchored in concrete slab above. Diagram shows arrangement of busways to switchboard sections.



indicates the fine job that has been done here. It also suggests how electrical modernization can be sold in other convention halls, exhibition and sport arenas and similar interiors.

Service Change

Prior to modernization, electric energy was delivered from a small underground utility vault alongside the Coliseum to a main switchboard in the Coliseum's basement at the back of the Music Hall (see plot plan). The utility has abandoned that vault and built two larger underground vaults near a corner of the Coliseum. Each of these vaults supplies one section of the new main switchboard mounted on a walkway around the Coliseum 15 ft above the floor level, behind the seats. Service to each section of the main switchboard is 3-phase, 3-wire 480 volts and consists of three ¼-in. by 6-in. copper bars per phase. The bars are totally enclosed, have 3000-amp capacity and the assembly is reinforced to withstand 100,000-amp short circuit. A single ¼-in. by 6-in. copper neutral bar is brought into each switchboard section from the vault and is terminated and grounded just inside the enclosure. Each board contains a 3000-amp, 3-pole main CB with a 100,000-amp I.C. Other CB's within the two switchboard sections protect feeders to the other parts of the electrical system.

Section I of the main switchboard supplies: a 600-hp, wound-rotor centrifugal air conditioning compressor in the basement, through a 1200-amp CB; a basement load center, through

an 800-amp CB; and transformer bank No. 1 in the abandoned utility vault, through a 1200-amp CB.

Section II supplies: a 600-hp synchronous motor centrifugal compressor alongside the other 600-hp compressor in the basement, through a 1200-amp CB; power to the Music



EMERGENCY PANEL, containing three fused switches and wall-mounted at main switchboard location, is fed through top by three No. 2's in 1½-in. conduit from main bus in section II of new main switchboard. Three No. 4's in 1¼-in. C come out of left side of enclosure and run to small 480/120-208-volt transformer groups supplying existing lighting panels on first floor. Two No. 10's in ¾-in. C come out of top of enclosure and run to a lighting panel through a transformer above ceiling of main area.

Hall, through a 700-amp CB; a second basement load center, through an 800-amp CB; and transformer bank No. 2 in the basement, through a 600-amp CB. Power factor correction for the 1200-hp of compressor load is obtained by the use of a synchronous motor compressor to offset the lagging PF of the wound-rotor induction motor compressor.

Three ¾-in. conduits, each carrying three 500 MCM RH conductors from Section I, come down into the abandoned utility vault to supply transformer bank No. 1. Three 500 MCM conductors per phase tie into the main bus in a panel feeding the transformers. The panel contains four 400-amp CB's, each feeding three 700 MCM cables in individual 4-in. fiber duct runs which existed under the vault slab and up to the four individual transformers. Each transformer is rated at 225 kva, 3-phase, 480/120-208 volts, dry type.

The 3-phase secondary of each of the transformers in bank No. 1 is fed through a 3-pole, 250-volt, 800-amp disconnect fused at 800 amps, to a 3000-amp, 3-phase, 4-wire ventilated feeder busway which runs along the ceiling of the vault above the transformers. This busway ties into old bus bars mounted on support racks in the corner of the old vault. Eighteen 600 MCM and six 250 MCM cables are connected to these bus bars and run in conduit down and underground to the old main switchboard in the boiler room below the stage of the Music Hall. This is now used as a feeder distribution panelboard for

Transformer Vault No. 1



INCOMING FEEDERS from section 1 of main switchboard consist of three 500 MCM RH conductors in each of three 3½-in. conduits; enter transformer vault No. 1 through wall and into wireway at upper right in photo; and tie into main bus of 3-phase, 3-wire, 480-volt CB enclosure shown. Three 700 MCM cables run from each of four 400-amps CB's underground in existing 4-in. fiber duct runs to four nearby transformers.

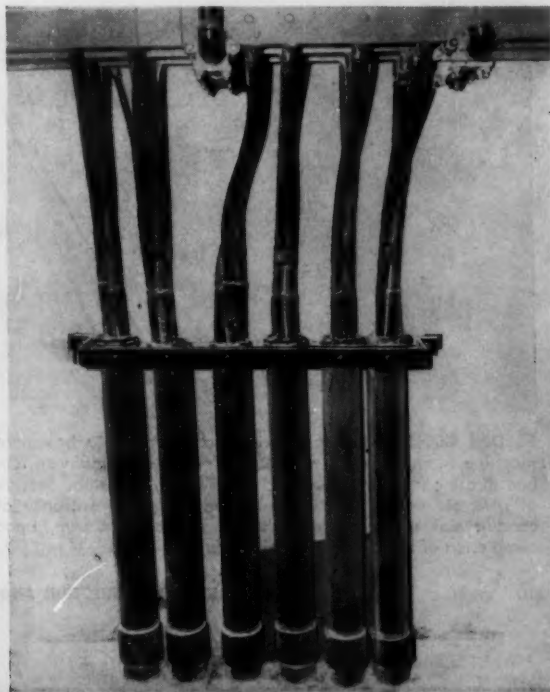


TYPICAL TRANSFORMER in bank of four is fed from CB enclosure in vault by cables in conduit which come up from floor under switch enclosure at right. Short section of duct between switch and transformer carries 480-volt primary cables to transformer. Another short section of duct near top of transformer carries 120-208-volt secondary cables to 3-pole, 800-amp switch, at right, which feeds 3000-amp, 3-phase, 4-wire ventilated feeder bus running above switch.

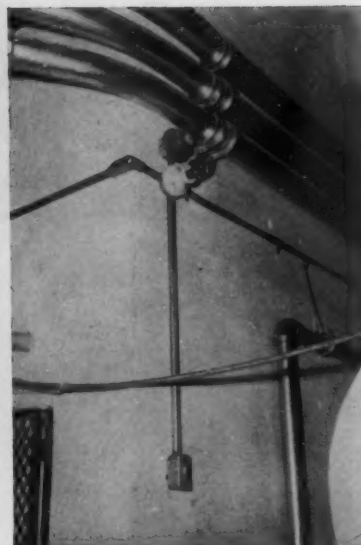
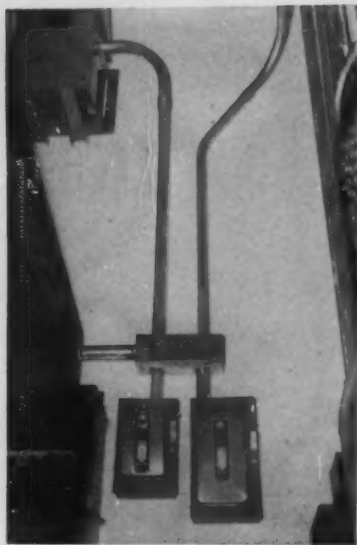
TRANSFORMER LINEUP in vault No. 1 looks like this behind the 800-amp switches at left. Busway at upper left is supported by rods anchored in slab above or in beams; runs to one end of vault where it connects to old bus bars mounted on support racks.



OLD FEEDERS from transformer vault No. 1 to old main switchboard consist of six sets of three 600 MCM and one 250 MCM cables, as shown here. Cables are connected at one end of vault to old rack-mounted bus bars (at top) fed by 3000-amp bus from transformer secondaries.

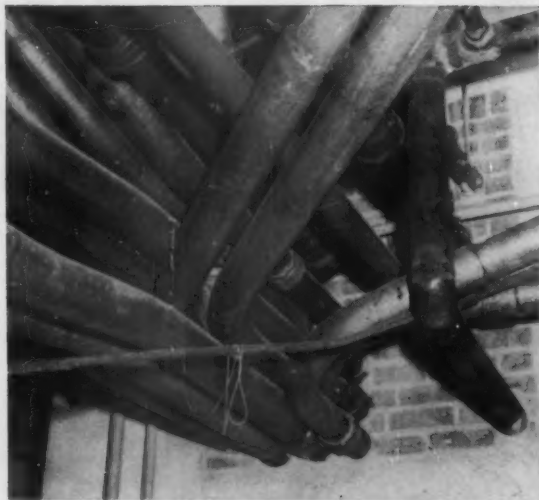


Boiler Room

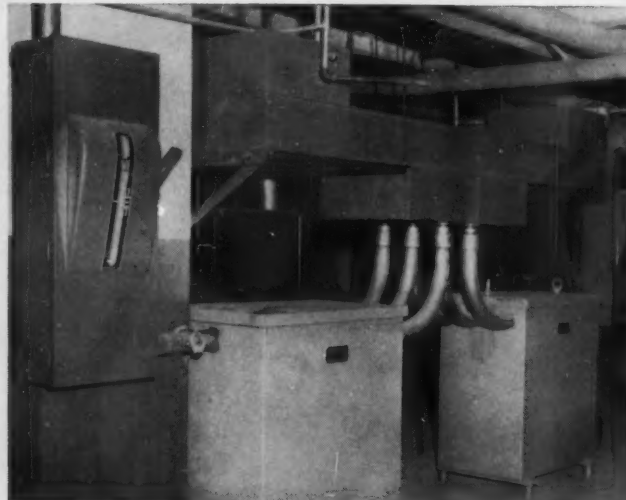


NEW TRANSFORMER, upper left, is one of three $7\frac{1}{2}$ -kva, 480/120-volt, single-phase transformers mounted on wall behind old switchboard and connected delta-wye. Transformers are fed from 30-amp, 3-pole fused switch at left. Switch at right is 60-amp, 3-pole fused and feeds 480-volt power through short section of conduit, at left of junction box, into old switchboard to tap existing feeder to old panel location where another transformer group is mounted. Conduit coming down from upper right is $1\frac{1}{4}$ -in. size carrying three No. 4's from emergency panel. Two switches shown are supplied by these conductors. Old switchboard (center) in boiler room is used as a feeder distribution panel for lighting and plug-in feeder busway on first floor. CB alarm (right) mounted on wall in boiler room indicates when any primary breaker opens in the panel in vault No. 1. Alarm consists of red signal light and bell with silencing switch; circuit ties into lighting panel in boiler room and runs to auxiliary contacts in breaker enclosure in transformer vault.

Basement

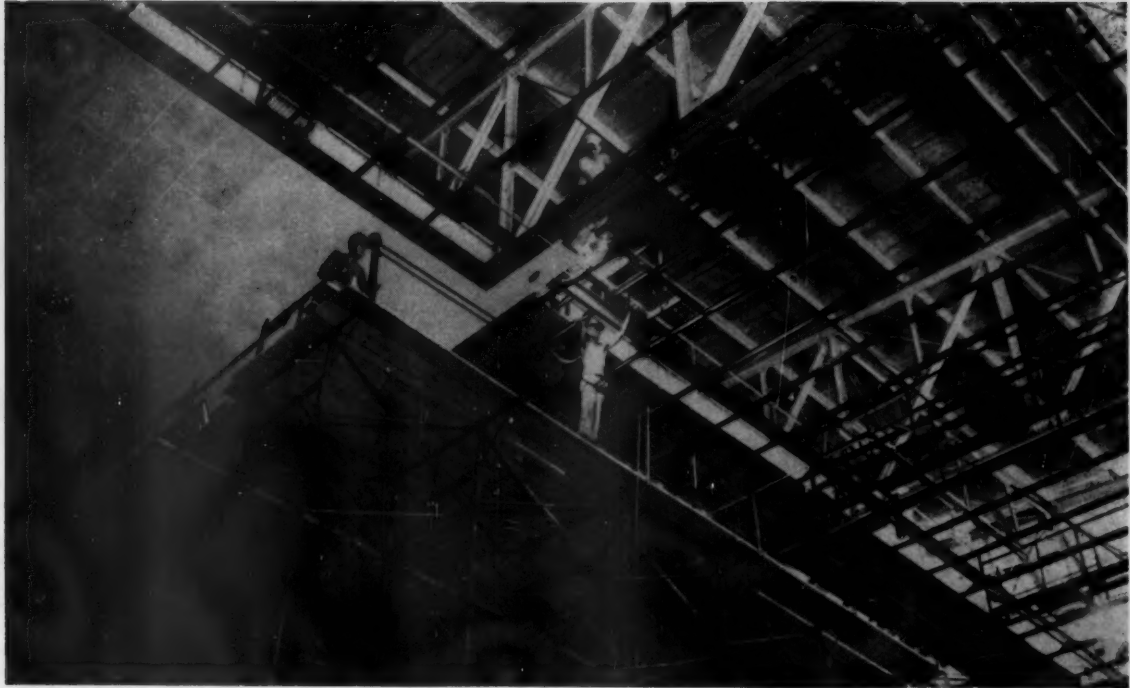


FEEDER CONDUIT, 3- and 4-in. sizes, come into basement machine room through wall. Runs originate at main switchboard; are carried in pipe trench below first floor slab. Section of concrete wall which was removed to permit entrance of conduit was replaced by brick and mortar as shown, upon completion of the installation of conduits.



TWO TRANSFORMERS—each 225 kva, 480/120-208 volts, 3-phase, 4-wire, dry-type—make up bank No. 2 in the basement and are supplied through individual 3-pole, 600-amp, 600-volt disconnect switches (left and right) fused at 300 amps. Three 3-in. conduits from each transformer curve up to a 3-phase, 4-wire secondary busway above the units.

Lighting



CEILING LUMINAIRES were installed from catwalks on trusses and from a scaffold. Plaster frames for fixtures were set in place as acoustical ceiling was hung.



MOUNTING ASSEMBLY of a typical ceiling luminaire is shown here from above. Channel-iron square frame is formed between channel-iron members of ceiling structural grid; fixture is attached to channel-iron square and set in plaster frame in acoustical tiles. Ease of maintenance was a prime consideration in this installation.



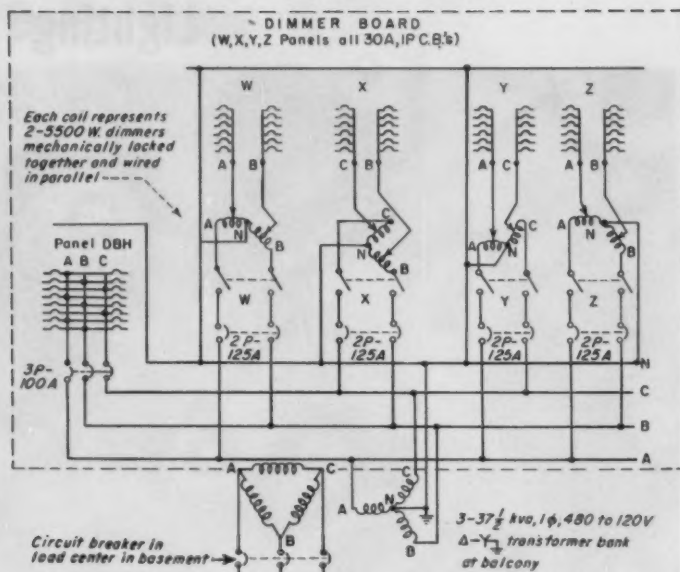
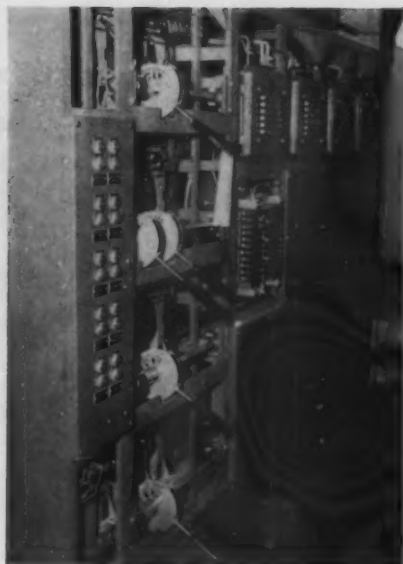
LIGHTING TRANSFORMERS—three 37½-kva, single phase, 480/120-240-volt units connected delta-wye for 120-208 volts, 3-phase, 4-wire—are mounted in room along one side of building at same level as new hung ceiling. Group is supplied from one of load centers in basement through 200-amp, 600-volt switch at left.

plug-in busway on the first floor.

As shown in the plot plan, the basement of the Coliseum is located under one end of the building. The two 600-hp air conditioning compressors, three old 125-hp compressors, a pair of 75-hp chilled water pumps, a pair of 50-hp condenser water pumps, other motor loads, old condensers and brine storage tanks, motor controls, two new load centers and transformer bank

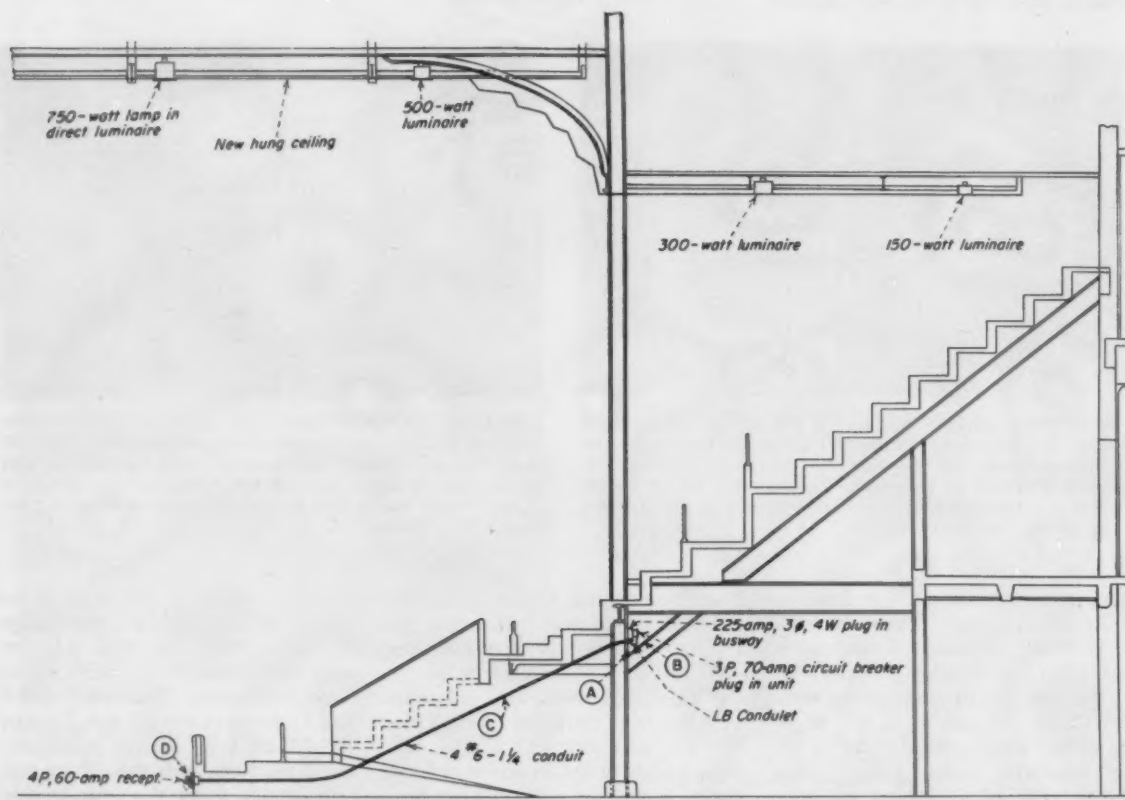
No. 2 are in this basement machine room. Old equipment in the room was supplied by feeders in three 4-in. conduits run in a pipe trench below the building edge, from the old main switchboard in the boiler room. These conduits were cut near old ice machine panels in the basement and extended to the starter for the synchronous compressor. Old cables were removed and replaced with new cables

from the breaker in Section II of the new main switchboard. New cables in conduit were run from the new main switchboard to the other equipment in the room. Transformer bank No. 2 consists of two 225-kva, 3-phase, 480/120-208-volt dry-type transformers. This bank feeds the old ice machine panels, a run of plug-in busway on the first floor and two pumps through a 3-phase, 4-wire panel.

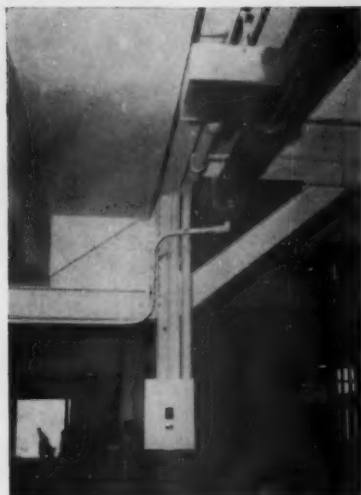


DIMMER BOARD in control room overlooking main interior houses four banks of four 5500-watt autotransformer dimmers. Each bank of four dimmers has a single handle. Handles are interlocked to provide individual operation of banks or operation of all banks together from master handle. At right are 1-pole CB panels for lighting circuits from dimmer board. At left are "ON-OFF" pushbuttons for controlling various groups of lights in building. A separate set of pushbuttons controls each of four dimmer-fed CB panels. Complete wiring diagram of 3-phase, 4-wire dimmer board is shown.

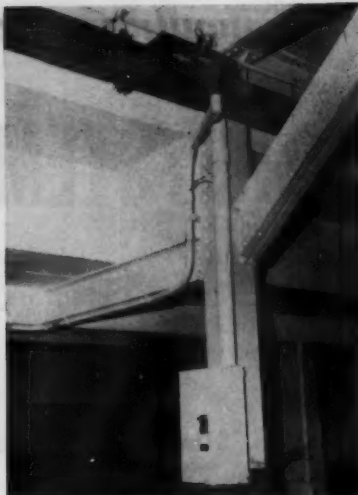
Main Floor



CROSS SECTION through Coliseum shows arrangement of lighting and distribution equipment. Circled letters indicate positions corresponding to those shown in photos.



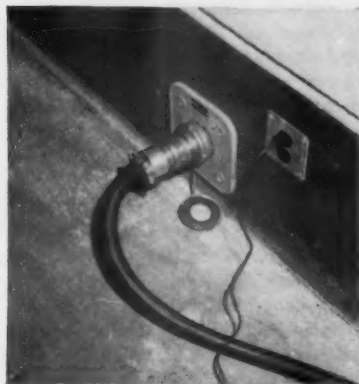
A. PLUG-IN BUSWAY runs around first floor of hall, mounted on structural steel under banks of seats, and is divided into two sections. Section shown here is fed by four 300 MCM in 3-in. C, from old main switchboard up through slab, through CB mounted on column and up in conduit to busway through top box at top. Busway provides ready availability of electric power at booths on exhibits set up in space under seats. Feeds to both busway runs were made in existing conduit in slab.



B. BREAKER UNIT plugged into busway (at top) is 3-pole, 70 amp size from which four No. 6's in 1 1/4-in. C are fed to a 4-pole, 60-amp receptacle on base of low wall around main exhibit area.

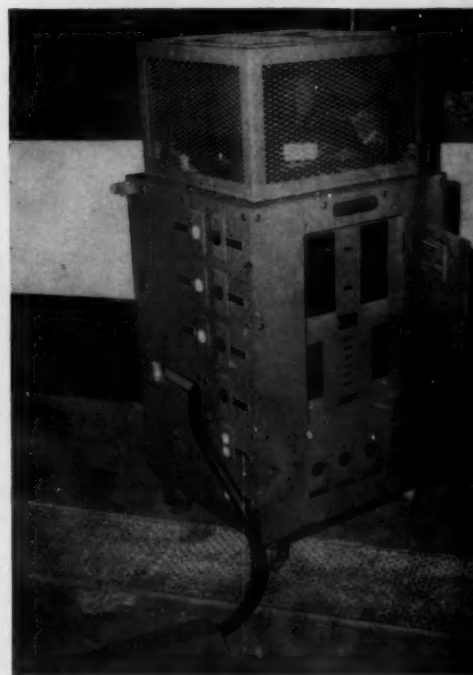


C. CONDUIT RUN from plug-in CB unit carries four No. 6's down under seats and through wall to 4-pole receptacle in main area. Conduit is supported by steel strap hangers bolted to concrete.



D. TYPICAL RECEPTACLE (left), one of ten such units around main area of hall, is a 4-pole, 4-wire, 60-amp flush receptacle. Cable with connector is shown here connected to receptacle. Standard 120-volt, grounded duplex receptacle is at right.

PORTABLE POWER is provided for various booths and exhibits throughout floor area of hall by four special enclosures mounted on casters for easy moving. Typical unit, above, contains: 20-amp, 208-volt, single-phase receptacles; 20-amp, 3-pole, 120-volt, single-phase Twistlock receptacles; 15-amp, 120-volt, single-phase, grounding type duplex receptacles; and 20-amp, 208-volt, 3-phase Twistlock receptacles. Receptacles are on both sides of enclosure. Open CB panel contains: a 50-amp, 3-pole main CB; two 20-amp, 3-pole CB's; two 20-amp, 2-pole CB's; and ten 20-amp, 1-pole CB's. Cable coming out of unit is four No. 4's with separate ground. Sixty feet of cable is provided in each unit, with a large manual windup reel within housing. Cable connects to 4-pole, 60-amp wall receptacle for power. Sheet steel walkover bridges are used to cover cable run from unit to receptacle, as shown. Cage at top holds extension cords.



The two load centers in the basement machine room are 3-phase, 3-wire, 480-volt circuit breaker enclosures. A wide variety of loads are fed from these centers, including: 19 air conditioning units on the run-around level; 4 escalators; a lighting dimmer board through transformers, on the balcony level; pumps; fans; and plug-in busway and lighting and recep-

tacle circuits, through transformer banks, in the Coliseum Annex.

An extensive system of feeders was installed on the switchboard and load center layout. New panels, conduit and wire were installed throughout the six levels of the Coliseum and in the Annex. Where possible, existing equipment was used; but no compromises were made with adequate-plus

capacity of cable, conduit, cabinets, panels and utilization circuits. Provisions were made throughout the building for load growth and extension of the electrical system.

Details of the modernization job are given in the accompanying photos and sketches.

Gulf Electric Co., Houston, Texas, handled the installation.

SOUND SYSTEMS—Part III

Covering wires, cables, connectors, installation techniques and miscellaneous data.

By **MORTIMER S. SUMBERG**, David Bogen Co., Inc., New York, N. Y.,
and **J. F. McPARTLAND**

IN Parts I and II we covered the construction, operation and application of the basic elements of sound systems. General system design was detailed from loudspeaker arrangements and impedance matching, through amplifier selection and hook-up, to the use of the various signal input devices such as microphones, record and tape players, radio tuners and signal tone generators. To complete the discussion, this article will cover the types of wires, cables, hardware and approved methods used in the installation of sound equipment. Figs. 19 through 24 show the types of wire, cable and connectors most frequently used in sound system work. These may be grouped in three categories to simplify discussion: (1) Input cables and connectors, (2) output cables and connectors, (3) power and control cables and connectors. It is important for the electrical man to understand at the outset that most of the wires, cables and connectors employed for audio work have been specially designed and constructed for this specialized type of service and that cables and connectors commonly used in power and light wiring are generally unsatisfactory for sound work and may result in troublesome operation. For example, it will become quite obvious from the data which follows that standard armored cable—which literally qualifies as a 2-conductor metallic-shielded assembly—is not electrically the same as a low impedance microphone cable which also is literally a 2-conductor metallic-shielded assembly. Microphone cables (high or low impedance) are carefully designed and constructed to

insure very low capacitance per running foot so that the higher frequencies of the audio signal will not be attenuated. Microphone cables are also much more flexible than power and light cable assemblies and are far easier to handle and install.

Input Leads

In any sound system installation, the cables which connect the microphone(s) or other input devices to the amplifier or which connect preamplifiers to booster amplifiers are called "input leads". Depending upon the particular input device and its distance from the amplifier, an input lead may be any one of several types of cable assemblies either run freely or carried in conduit from the device to the amplifier. Data on the more common types of input leads are as follows:

Microphone Cables—In general, there are two types of specially designed cables used to connect microphones to amplifiers: (a) high impedance cable, (b) low impedance cable.

High impedance microphone cable (see Figs. 19 and 21) is run in lengths not exceeding 50 ft between a high impedance microphone and the high impedance input on the amplifier or pre-amplifier. This cable consists of a single rubber (or plastic) insulated stranded conductor carefully enclosed in a braided (or spiral) tinned copper shield. Protecting this assembly is an outer insulating sheath of rubber or plastic. The single inner conductor carries the audio signal and the shield is used as a return. The shield is always grounded at the amplifier chassis through the terminating con-

ductor. High impedance microphone cables—because they are limited to maximum runs of 50 ft.—almost never have to be pulled through conduits. Since the cable usually is exposed to foot traffic it is important that the protective rubber or plastic jacket be heavy enough to prevent damage. Cable manufacturers furnish high impedance microphone cables with varying outside diameters to insure satisfaction of all kinds of installation requirements.

Low impedance microphone cable differs in that two conductors are used to carry the signal—each electrically balanced to ground. Because of this, a low impedance microphone cable must be terminated by a different type of connector. (See Figs. 20 and 23.) As explained in Part II, low impedance microphone cables must be used (with a low impedance microphone) when the cable length is greater than 50 ft. It follows that the input of the amplifier must be provided with a low impedance receptacle to complete the termination.

Since low impedance microphone cables frequently are run to lengths of 500 ft, the general practice is to pull the greater length of the cable in conduit. Figure 22 is offered as a very rough guide to the number of microphone cables which may be pulled in standard conduit. Although rubber covered cables may be pulled through conduit and are widely used, cables with plastic jackets are easier to pull and therefore preferred. To simplify the job, the installer may use a standard pulling lubricant. Unfortunately, all too frequently electrical contractors will attempt to pull too many microphone cables through a

conduit with several bends and, by exerting too much force on the cables, will cause intermittent breaks and shorts which require considerable time and money to correct. Shielded cables with cotton conductor insulation should never be used for carrying the microphone signals through conduit since moisture gets in easily and will almost always lead to trouble.

Although any number of microphone cables may be run in one conduit, it is the safest practice not to include speaker cables or ac power wires in this conduit. If these differing cables are run in one conduit, hum almost certainly will be introduced into the system, and there is an excellent chance that the coupling between the speaker and microphone cables will set up a condition of oscillation.

At the amplifier end of the conduit, the cable may be terminated by a connector of the type shown in Fig. 23. The exploded view shows clearly how this component is disassembled; a relatively simple matter. Connections to the front lugs in the connector should be made with extreme care to prevent against cold soldered joints which introduce resistance or which frequently cause intermittent operation. Since most microphone cables use a vinyl plastic insulation the installer should apply no more heat to the lugs and the cable conductor than is absolutely necessary. Surprisingly enough, a small number of electrical men are still using acid-core solder (a certain trouble-maker) in place of the highly recommended rosin core solder which insures trouble-free operation over long periods.

If microphone cable must be spliced (a practice which should be discouraged) the sound installer should recognize the fact that the shield must be made electrically continuous and that the splice should be as carefully shielded as possible. Usually it is not too difficult to push back the shield on both wires which are to be spliced and then to force the shielding over the splice after it has been carefully taped. The two sections of the shield which have been brought together should be carefully soldered.

At the microphone end of conduit a receptacle of the type shown in Fig. 24 is usually located. In inside installations, this component would be mounted on a single gang wall plate. Although wall mounting of the microphone receptacle is preferred, it sometimes becomes absolutely necessary to install the outlet in the floor (i.e., on a stage) in which case consideration

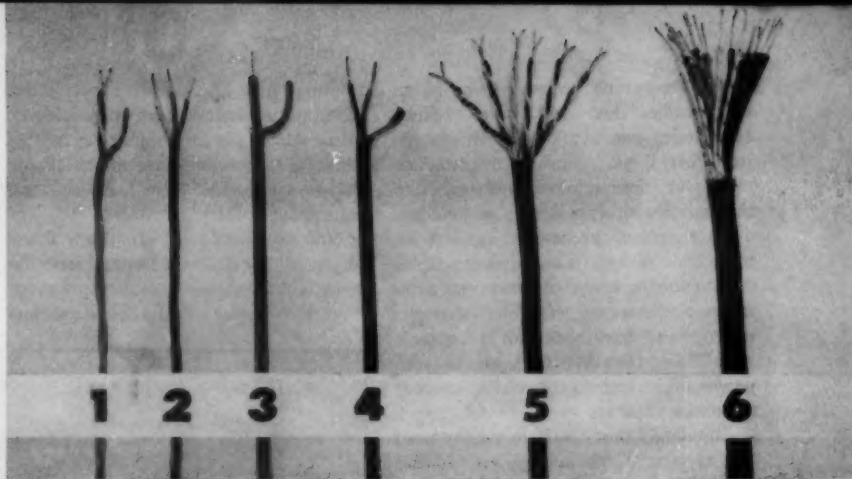


FIG. 19—TYPES OF CABLES USED IN SOUND SYSTEMS vary in design and construction, each having characteristics suited to a particular application in a system. The various cables shown above are as follows: (L-R)

1. Shielded single twisted pair (a twisted pair of plastic-insulated #20 AWG wires, with an overall shield of braided tinned copper) for use in intercom systems, between preamplifiers and booster amplifiers when the preamp has low impedance output, and for multiple speaker lines in common conduit when cross-talk must be prevented.
2. Unshielded three-conductor cable (three plastic-insulated #20 AWG wires, with a plastic outer jacket) for use primarily in intercom systems.
3. High impedance microphone cable (a single plastic-insulated conductor within a shield of braided tinned copper, with a plastic outer jacket). See FIG 21.
4. Low impedance microphone cable (two plastic-insulated conductors within a shield of braided tinned copper, with a plastic outer jacket). See FIG 21.
5. Six individual twisted pairs (plastic-insulated #20 AWG wires, with an overall outer jacket) for use in intercom systems.
6. Twenty-conductor cable (cotton-rubber insulated #20 AWG wires, with an overall outer jacket) for use in intercom systems.

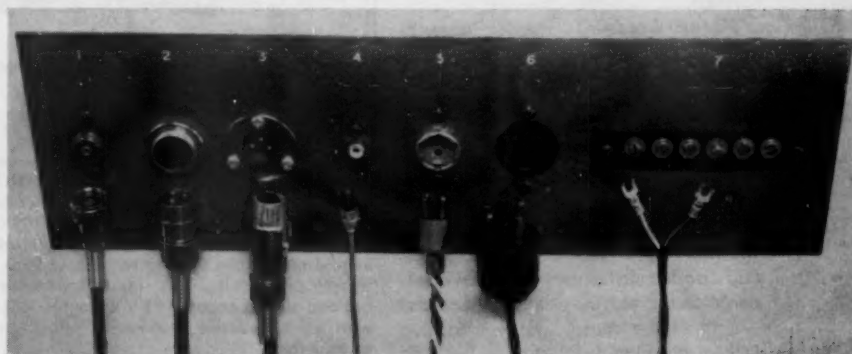


FIG. 20—CONNECTORS USED IN PAGING AND MUSIC SYSTEMS, both plugs and receptacles, are shown here assembled on a single panel to provide clear comparison of the various types. Descriptions and applications are as follows: (L-R)

1. Amphenol high impedance microphone cable connector (screw-on type) and receptacle for use with crystal or high impedance dynamic microphone.
2. Amphenol low impedance microphone cable connector (screw-on type) and receptacle for use with low impedance dynamic, velocity or cardioid microphone.
3. Cannon microphone cable connector (plug-in type with latch-lock device) and receptacle, widely used today with either high or low impedance cable. See FIG. 23.
4. RCA-type phono plug and phono jack for use with single-conductor shielded cable connecting a record player or radio tuner to an amplifier.
5. Typical Alden multi-prong plug and receptacle for use with multi-conductor cables connecting accessory devices (e.g., relay for standby operation or remote volume controller) to an amplifier.
6. Multi-prong speaker plug and receptacle commonly used to connect loudspeaker cable to an amplifier in applications which require ready disconnection of the loudspeaker(s)—such as in portable sound systems.
7. Typical amplifier output terminal strip providing several output impedance values for matching the speaker load to the amplifier. The speaker line (unshielded single twisted pair of insulated wires, with an overall cotton jacket) is equipped with two terminal lugs which are inserted and held under the two screws providing the required output impedance. Invariably, the terminals on the strip are marked as to their values. (Note: Except for the terminal strip, all of the above receptacles are frequently mounted on wall plates as well as on amplifier chassis. All of the cables shown require soldered connections to lugs within the connectors.)

should be given to protection from foot traffic, dust and water. Since receptacles are available with matching dust caps (some with attached chain to prevent loss), damage to the component can easily be avoided.

As a general precaution against interference pickup in microphone cables due to the presence of stray magnetic fields, the exposed cable between the microphone and the wall receptacle should be installed well away from power, light and signal wiring serving the same area.

Standard thin wall conduit used for regular light and power wiring is used for running microphone cable. Thin conduit or fiber duct should be used for running microphone cables in concrete. Where severe climatic conditions prevail or where the conduit run may be exposed to dampness or corrosive conditions, care should be taken that the conduit used has the proper characteristics to protect the cable. Galvanized heavy wall conduit is well suited to such application. And where necessary, conduit runs should be provided with plugs or weep outlets at low points to allow escape of moisture which might collect in the conduit.

Phono Leads—The cable used to connect record players (manual or automatic) to amplifiers is invariably a single conductor shielded assembly of the type shown in Fig. 20 No. 4. The cable is almost always terminated with the RCA-type phono plug shown in the illustration. As in the case of a high impedance microphone cable, the inner conductor carries the signal and the braided shield—carefully soldered to the plugs at the amplifier end—acts as the return. Except for the lack of an outer insulating jacket, this cable is very similar in construction to high impedance microphone cable.

Radio tuners, record players and tape recorders are usually sold with a suitable length of cable to which a phono plug has been soldered (at the factory). Should the installer have to attach the phono plug himself, he will find the operation a relatively simple matter. The first step consists of unbraiding the woven shield with a sharp instrument so that approximately 1-in. of the conductor and insulation are exposed. After carefully removing part of the insulation and twisting the outer shield, the inner conductor is introduced into the phono plug and soldered to the pin at the tip. A soldering iron is used for this purpose and care should be taken not to apply too much heat since the insula-

tion may melt and cause a short. After the inner conductor is securely soldered to the end of the center pin, the twisted shield is then wound around the lip of the outside shell and soldered for continuity.

Other Input Leads—In Parts I and II we briefly described sound installations which employ a remote pre-amplifier at the point of microphone pickup

working into one or more booster amplifiers at outlying points. Since the output signal from the pre-amplifier is usually run over a considerable length of cable, it is standard practice to employ a pre-amplifier with a low impedance output and booster amplifiers with low impedance inputs. Low impedance microphone cable or a single twisted pair of shielded cable (see

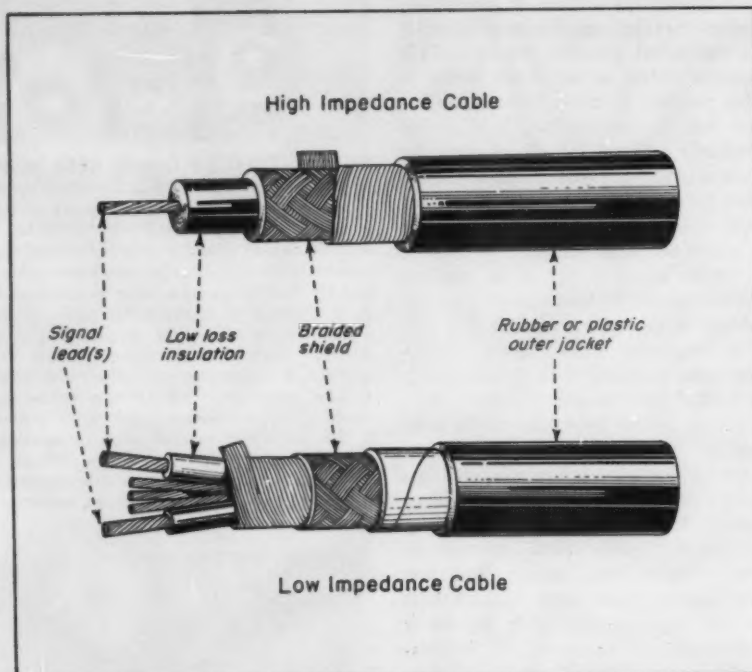


FIG. 21—TWO TYPES OF MICROPHONE CABLE are shown here. At top is high impedance microphone cable—a single rubber or plastic insulated conductor within a shield of braided tinned copper, with an outer jacket of rubber or plastic. This cable is used with crystal or high impedance dynamic microphones and generally should not be run in lengths greater than 50 feet. At the bottom is low impedance microphone cable—two rubber or plastic insulated conductors within a shield of braided tinned copper, with an outer jacket of rubber or plastic. This cable is used with low impedance dynamic or velocity microphones and may be run in lengths up to 500 feet.

NUMBER OF CABLES IN CONDUIT	REQUIRED SIZE OF CONDUIT* (INCHES)	HIGH IMPEDANCE MICROPHONE CABLES — OUTSIDE DIAMETER = 0.245"
1	1/2	LOW IMPEDANCE MICROPHONE CABLES — OUTSIDE DIAMETER = 0.28" OR 0.231"
2	1/2 or 3/4	
3	3/4	
4	3/4 or 1	
5	1	
6	1 1/4	
7	1 1/2	
8	1 1/2	
9	2	

*For runs up to 150 ft. with two 45° bends. Plastic outer jacket will pull easier than rubber. Data in the table is approximate; installer should use slightly larger conduit than may seem necessary. Where conduit is already installed and apparently too small, consider use of cables with 0.231" O. D.

FIG. 22—NUMBER OF MICROPHONE CABLES IN CONDUIT

Fig. 19 No. 1) may be used for this purpose. Even though the signal level in this cable is considerably higher than that carried over microphone cables, it is best to route it well away from speaker and power cables. As with microphone and phono cables, connectors should be attached with considerable care to insure against intermittent conditions.

Output Leads

Those cables which are run from the output taps on the amplifier to the system loudspeakers (either directly or through line matching transformers) are usually called "output leads". Such wiring is not usually susceptible to interference from power or signal circuits and does not ordinarily require the shielded conductors used

with microphones. In some special sound installations—as in a school system where the classroom loudspeaker is often employed for intercom purposes—the loudspeaker line may have to be shielded. In the latter case a shielded single twisted pair cable of the type shown in Fig. 19 No. 1 may be used. In multi-channel sound systems installed in hotels and hospitals it is also standard practice to use shielded twisted pair speaker lines to prevent cross talk (transfer of a signal from one line into an adjacent line). In the majority of speaker hookups, however, an unshielded single twisted pair cable with an outer cover of cotton braid or vinyl plastic (Fig. 20 No. 7) is generally used. As a matter of fact, where cross talk is no problem, any two conductors (e.g., zip cord) will do the job.

Earlier in this article the electrical man was cautioned against running microphone and speaker cables in the same conduit. Infrequently an oversight in the initial planning stages will leave the installer with no choice but to do this. If the runs are moderate in length (e.g., 100 or 200 ft) there is a good possibility that instability and oscillation can be avoided if shielded speaker cables are used. The practice is not recommended, however, and is to be discouraged unless there is no other way out.

Speaker cables in most sound installations employ No. 20 or No. 18 AWG conductors. The table shown in Fig. 26 will serve the installer as an excellent guide when the speaker lines are extremely long. It will be noted that as the output impedance of the amplifier increases in value the smaller

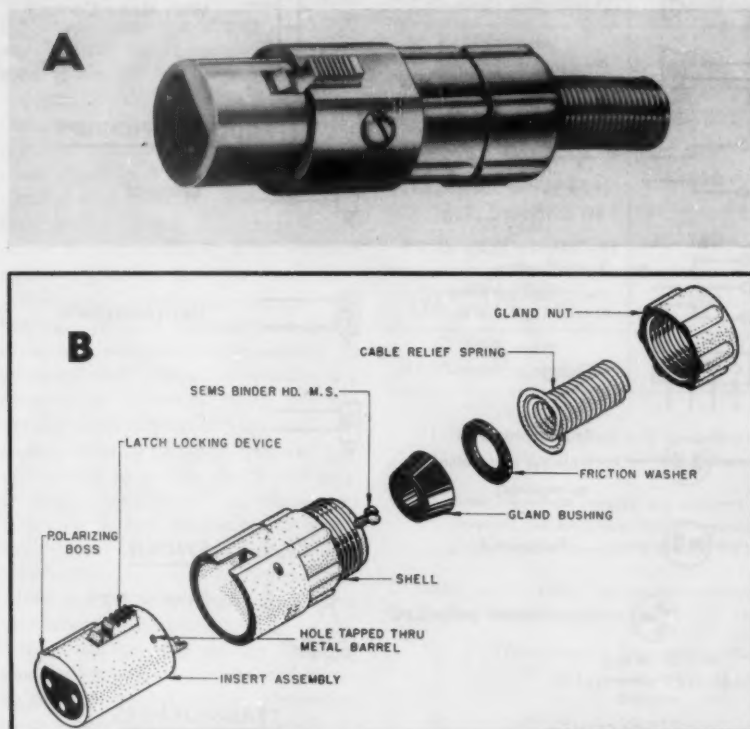


FIG. 23—TYPICAL MICROPHONE CABLE CONNECTOR is the Cannon XL-3-11 connector used with either high or low impedance microphone cable. This component easily plugs into a matching receptacle (See FIG. 24) and may be disconnected only by releasing the latch-lock device.



FIG. 24—MICROPHONE RECEPTACLE which matches the Cannon XL-3-11 connector (See FIG. 23) is widely used on both amplifier chassis and wall plates at remote microphone locations.

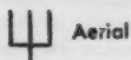
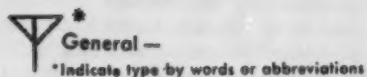
SIZE OF WIRE IN SPEAKER CABLE (AWG)	REQUIRED SIZE OF CONDUIT (INCHES)										
	1	2	3	4	5	6	7	8	9	10	20
	pr.	pr.	pr.	pr.	pr.	pr.	pr.	pr.	pr.	pr.	pr.
20	½	½	½	½	½	½	¾	¾	¾	1	1
18	½	½	½	½	¾	¾	1	1	1	1¼	1½
16	½	½	½	¾	¾	1	1	1	1	1¼	1½
14	½	½	¾	1	1	1¼	1¼	1¼	1¼	1½	2

NOTE: This table contains recommended sizes of conduit, based on the use of unshielded single twisted pairs of solid or stranded, rubber or plastic insulated conductors. This table is only an approximate guide; conduit length and number of bends should be carefully considered.

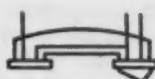
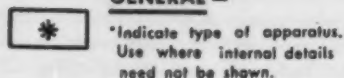
FIG. 25—NUMBER OF LOUDSPEAKER CABLES IN CONDUIT

SYMBOLS USED IN SOUND SYSTEM WIRING PLANS

ANTENNAE

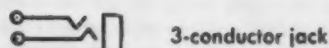
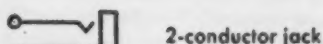
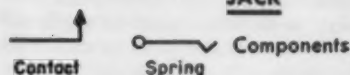


GENERAL —

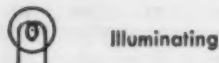
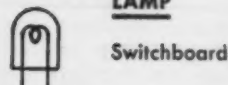


3-conductor

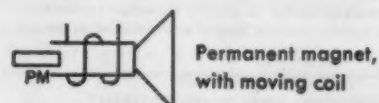
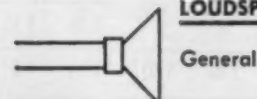
HAND SET



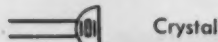
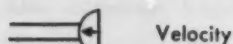
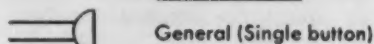
LAMP



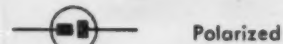
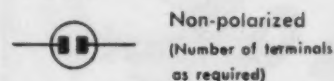
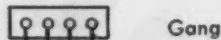
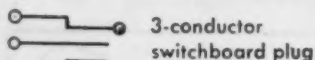
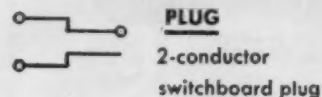
LOUDSPEAKER



MICROPHONE

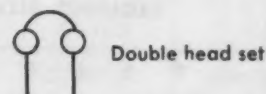
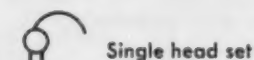
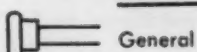


PLUG

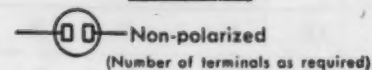


Radial prong
indicates polarization

RECEIVER

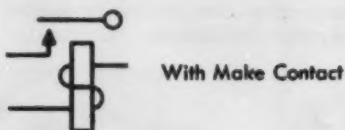


RECEPTACLE

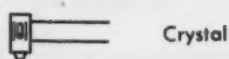
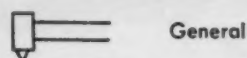


Radial contact
indicates polarization

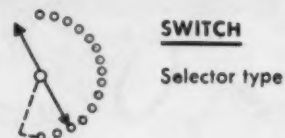
RELAY



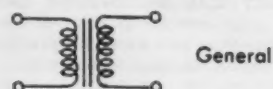
REPRODUCER (PICK-UP)



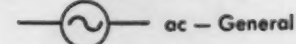
SWITCH



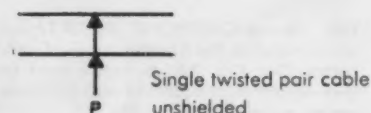
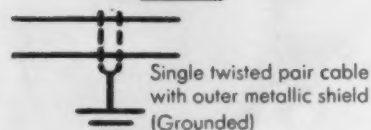
TRANSFORMERS



VOLTAGE SOURCE



WIRING



becomes the required copper diameter of the speaker cable. Obviously, speaker hookup to amplifier output impedance values of 8 and 16 ohms (furnished on the terminal strip of most amplifiers) should be avoided if higher impedance values are available on the same terminal strip. As an illustration, it is possible to run a speaker line for 900 ft using No. 22 cable provided that a 500 ohm output tap on the amplifier is used. If a 300 ohm tap on the same amplifier were used, a No. 20 AWG cable would be required for the same 900 ft run. Impedance matching between the amplifier and loudspeaker was covered in some detail in Part I and it will be recalled that most P.A. amplifiers do provide the output impedance values which No. 18 or No 20 AWG speaker cables require for low line loss.

There are several ways to run output leads from an amplifier to a group of widely separated loudspeakers. In an installation where loudspeakers are mounted at distances which are not greatly removed from the amplifier, each speaker or group of speakers may be supplied by a separate twisted pair. In larger installations and where area selection is not necessary, a single twisted pair of relatively heavy cables may be run common to all loudspeakers which are tied in through suitable line matching transformers.

The use of conduit for running loudspeaker wires may be either required or recommended, depending upon the conditions which prevail. In cases where protection is needed, over and above the protection afforded by the insulation in the cable, it is recommended that conduits be used. Thin wall conduit is usually satisfactory but heavy wall conduit is indicated where severe climatic or corrosive atmospheric conditions prevail. Infrequently, lead-covered cable is used in extremely damp locations (i.e., speaker lines run underground) to provide maximum protection. Loudspeaker cables may be run in ventilation or air ducts or closely fitted to wall molding. Connections at the loudspeaker end (at line matching transformer (are made by soldering to lugs. At the amplifier end, lugs of the type illustrated in Fig. 20 No. 7 are generally used. In portable or mobile systems where it is desirable to disconnect the speaker line from the amplifier without the use of tools, a plug is employed (see Fig. 20 No. 6). When pulling a large number of speaker cables through a conduit the installer should not forget to label each line so that the time con-

AMPLIFIER OUTPUT TAPS FEEDING SPEAKER HOOKUP (1)	MAX. LENGTH OF SPEAKER CABLE-Feet (2)			
	#20 AWG PAIR	#18 AWG PAIR	#16 AWG PAIR	#14 AWG PAIR
500 ohm	1200	2000	3000	4000
250 ohm	700	1100	2000	3000
70 volts (10-watt amplifier)	1200	2000	3000	4000
70 volts (15-watt amplifier)	950	1600	2000	3000
70 volts (30-watt amplifier)	450	750	1200	2000
70 volts (50-watt amplifier)	290	450	750	1200
70 volts (100-watt amplifier)	150	230	360	560
140 volts (50-watt amplifier)	1100	1800	2800	4000
140 volts (100-watt amplifier)	590	950	1600	2000

(1) The taps to be used will be determined on the basis of the hookup of the line matching transformers for the loudspeakers — see Part I.

(2) These maximum lengths are one-way distances from amplifier to line transformer. They are the maximum lengths speaker cables can be run without exceeding 10% power loss (an acceptable loss) in the line.

NOTE: In the table, the constant voltage amplifier taps are equivalent to impedance values as follows:

70-volt tap on 10-watt amplifier	= 500 ohms
" " " " 15-watt "	= 333 "
" " " " 30-watt "	= 167 "
" " " " 50-watt "	= 100 "
" " " " 100-watt "	= 50 "
140-volt " " 50-watt "	= 400 "
140-volt " " 100-watt "	= 200 "

FIG. 26—SIZE OF WIRE FOR LOUDSPEAKER RUNS

suming operation of buzzing out each line later can be avoided.

In school systems and some commercial installations where area selection is a feature of the over-all design, each loudspeaker or a particular group of loudspeakers will be connected at the main cabinet rack or console through a numbered area selector switch and this will require, of course, positive identification of each speaker line.

In Figure 25 is presented a rough indication of the number of loudspeaker twisted pair cables which may be run in conduit of varying diameters. To avoid tight pulls which can cause breaks in the cable, shorts, or intermittent operation, it is highly recommended that a conservative approach be employed in determining

conduit size. It need hardly be mentioned that bends in the conduit—as well as different cable diameters—will seriously alter the figures shown in the chart.

Power and Control Leads

Almost all sound systems which the electrical man will be called upon to install will require a source of 115 volts a.c. In mobile installations an amplifier will be selected which will operate from a 6-volt or 12-volt battery. In locating the amplifier, console, or complex cabinet rack, careful consideration should be given to adequate ventilation. And infrequent service checks require that access be gained to the equipment without much difficulty.

Since even the largest sound systems

DEFINITIONS OF TERMS USED IN SOUND WORK

ACOUSTICS — The auditory characteristics of a room resulting from the production, transmission, reception or effects of sound within it.

ACOUSTIC FEEDBACK — The transfer of sound from the loudspeaker back into the microphone in such a manner as to create an annoying squeal or howl.

ACOUSTIC TREATMENT — The use of special sound absorbing material to reduce echos and to control reverberation.

AMPLIFIER — In a sound system this usually refers to a device of electronic components used to strengthen the originating signal from a microphone or record player to the point where it will operate loudspeakers.

BAFFLE — Most commonly used synonymously with loudspeaker housing and may be a suspended, or surface or recessed, ceiling or wall mounting device made of wood, plastic or metal, in which a loudspeaker is housed.

BOOSTER AMPLIFIER — An amplifier designed to boost the level of a signal from a pre-amplifier to provide power for driving loudspeakers.

DECIBEL — A unit used to measure the relative loudness of sound. Engineers employ the complex term also to designate power or voltage ratios.

GAIN — Usually expressed in decibels, this term is applied to indicate the increase in voltage or power output over the voltage or power input.

HIGH IMPEDANCE — Literally the total opposition that a circuit offers to the flow of alternating current. Primarily used in the sound field as an important characteristic of amplifiers, microphones and accessories.

LOSS — A term usually expressed in decibels to indicate the decrease of voltage or power output from voltage or power input.

LOW IMPEDANCE — See High Impedance. Usually applies to 500 ohms or less.

MICROPHONE — A device which converts sound waves into corresponding audio-frequency electrical energy.

MIXER — Usually a pre-amplifier which permits several microphones, record player and/or radio tuner to be combined through volume controls. The suitably mixed signal is then usually fed to the input of a booster amplifier.

MONITOR LOUDSPEAKER — A small loudspeaker mounted in a console or cabinet rack (or adjacent to these) which provides an audible indication of the sound level of the system and which permits preliminary adjustment of the amplifier output before distribution to remote loudspeakers.

PRE-AMPLIFIER — Frequently used synonymously with mixer, although it may be designed to provide for increasing the level of only one input signal.

RADIO-TUNER — Similar in appearance and operation to a conventional radio receiver permitting reception of AM or FM programs. Differs from receiver in that it does not incorporate audio amplifier and loudspeaker.

REPRODUCER — The cartridge mounted in the tone arm which tracks the record grooves by means of a stylus (needle), picking up the electrical signal equivalent of the music or sound which was recorded.

TURNABLE PICKUP — Includes the tone arm, cartridge and stylus (needle) which follows the record grooves and provides an electrical signal suitable for feeding into a pre-amplifier, mixer or amplifier.

VOLUME LEVEL INDICATOR — A device (meter, neon bulb, etc.) which permits the operator of a sound system to determine visually the sound level output. Usually incorporated in consoles, cabinet racks and pre-amplifiers.

very rarely employ amplifiers whose total drain from the power line exceeds 10 or 20 amps at 115 volts ac, the trained electrical man will require no special instructions regarding this phase of the installation. Connection between the equipment and the power line is made exactly as it would be if a large blower fan or machine tool were used. The installer should not confuse the amplifier power output with the power consumption figure. For example, a typical amplifier rated at 50-watt output will consume 240 watts from a 115-volt ac line.

If a system incorporates microphone precedence (e.g. muting of the music during the brief period when a paging announcement is made) or remote control of volume (see description of this feature in Part II) it will be necessary to run special control leads. The latter frequently terminate at the amplifier through Alden or Cinch plugs of the types illustrated in Fig. 20 No. 5 and 6. The number of conductors in

the control cable—and the corresponding number of pins on the connector—depends upon the amplifier design and will be stipulated by the manufacturer of the equipment.

In large amplifier systems drawing a considerable amount of power from the ac line, a standard practice is to include standby control which greatly reduces the drain from the line during those periods when the system is not in actual use. To place the amplifier in operation for a paging announcement a 6-, 12-, or 24-volt built-in relay is energized by shorting a 2-conductor cable point through a switch located close to the microphone.

The sound specialist from whom the packaged amplifier (or custom assembly) is purchased should be consulted if any questions arise regarding the total ac drain for the equipment or the types of control cables which should be installed. Following standard practices, the installer should always ground the equipment to avoid shocks.

GENERAL INSTALLATION TIPS

1. Never use acid core solder. Rosin core solder is recommended.
2. Do not attempt to force too many cables through a conduit. Breaks, shorts, or intermittent operation may result.
3. Always ground amplifier, console or cabinet rack.
4. Do not run speaker and microphone lines in the same conduit. Never run either of these in the same conduit with power cables.
5. Label speaker cables before pulling through conduits so that identification of each twisted pair is simplified.
6. Do not use ac-type convenience outlets where specially designed microphone connectors are indicated.
7. When splicing shielded cable, make certain that shield is continuous and carefully soldered at the joints.
8. When soldering conductors with vinyl insulation (to connectors or lugs) avoid excessive heat.
9. Audio cables are specially designed and building wire should not be substituted.
10. Check with sound specialist from whom equipment is purchased when in doubt as to cable or connector to use.
11. When loudspeaker cables are run over very great distances, carefully determine required copper diameter of conductor.

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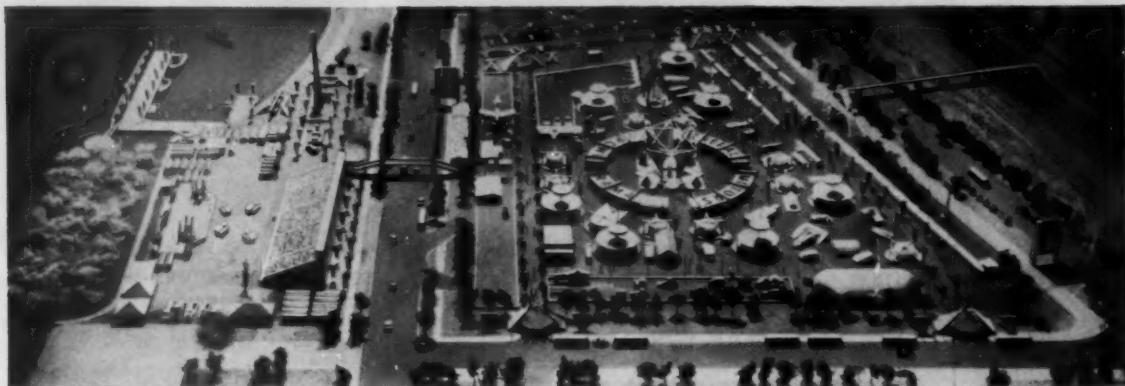
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VIEW OF POWERAMA on Chicago's lake front. Outdoor stage, grandstand and marine display on left. Main theme center with seven surrounding theme areas are at right.

Plastic Raceways Carry

Power for G.M. Powerama

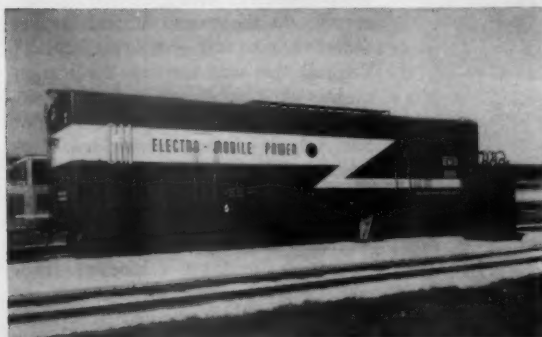
underground throughout 23-acre Chicago lakefront site. Mobile diesel-generator units provide electric energy.

SEVERAL "firsts" were among the features of the General Motors Powerama, a glamorous epic of diesel engines staged on a 23-acre site just south of Soldiers Field on Chicago's lakefront. From Aug. 31 through Sept. 25, the general public was given free rein to visit the 250 exhibits and displays demonstrating the contributions of diesel power to the American economy. The gigantic show, reportedly the first of its kind to dra-

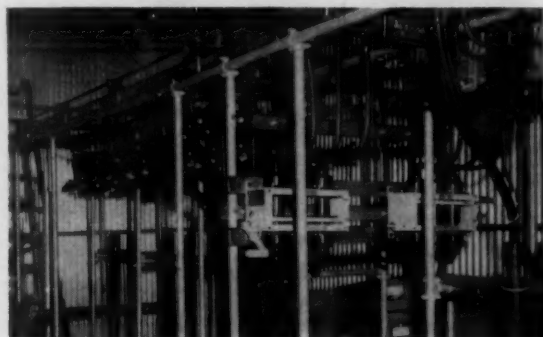
matize the comprehensive application of diesel engine and gas turbine power, celebrated the production this year of General Motors' 100 Millionth Diesel Horsepower.

Two of the "firsts" dealing with electrical generation and distribution were of more significance to the electrical men attending. One, which could be seen in operation, was an extensive test of mobile generating equipment as the sole power source for the show.

Four 1000-kilowatt Electro-Mobile rail units, operating in combination as a single generating plant, provided 4,160-volt power for the tremendous lighting and miscellaneous power loads. Motive power for the heavy "action" exhibits was provided by diesel engine units. A fifth 1,000-kw. rail unit was for demonstration purposes and dissipated its power through a transformer bank into group of grid resistors. The use of the mobile power units elimi-



FOUR MOBILE GENERATOR units (diesel-electric) like this 1,000 kilowatt rail car unit provide all the electrical energy for the show. A fifth unit for demonstration will show how units can be controlled from remote points.



PRIMARY SWITCH HOUSE adjacent to mobile generator units control underground circuits to 10 substations spotted throughout the exhibit area. Cables to generator cars are in steel conduit; those to substations in flexible plastic conduit.



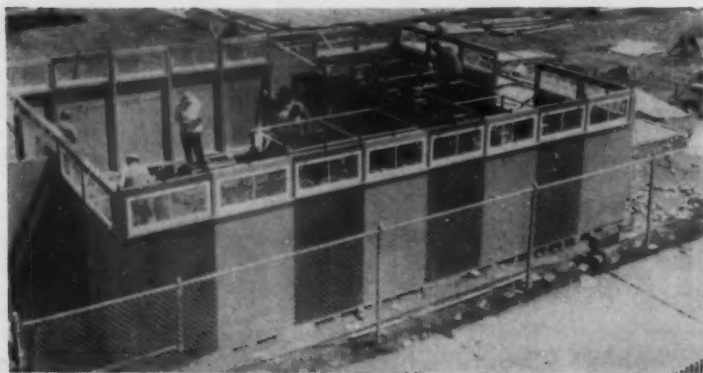
FLEXIBLE PLASTIC CONDUITS of 4-inch size lie in trench. Coils of raceway were unrolled in trench, have splices (couplings) every 100 feet.



FEEDING PRIMARY cables into plastic conduits in cement-block manhole. Two men at another manhole made the 200-ft. pull by hand.



SQUEEZE CONNECTORS terminate plastic conduits at switch enclosures. Conduits are trained up to box knockouts after cables have been pulled.



PREFABRICATED HOUSE goes up around substation and dimmer control equipment for huge stage while electricians are still connecting circuits.



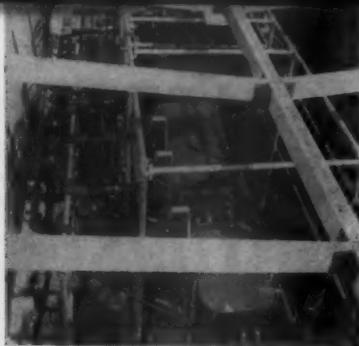
FLOODLIGHTS ARE mounted and wired to top section of theme center tower on ground. Each of seven towers is 60 feet tall and has a total of 81 500-watt units.



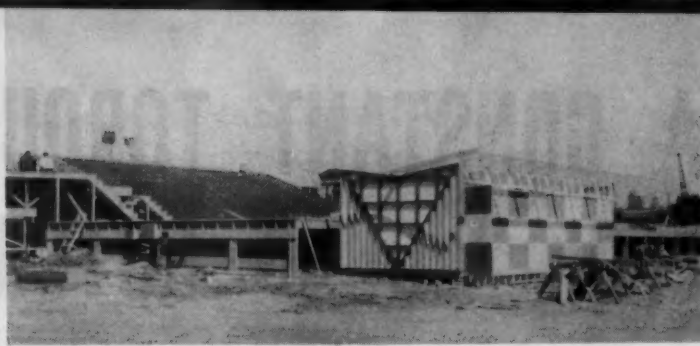
STRAIGHT PULLS without sharp offsets was a distinct advantage of flexible plastic conduit. Here two electricians pull in 14 No. 6 TW conductors for stage lighting dimmer control. Note typical substation arrangement in background with secondary fused switches for secondary circuits.

nated the expensive alternative of stringing a temporary power line from the nearest substation some two miles away and tunneling under an expanse of main line railroad tracks to reach the site.

Of equal interest to the electrical contractor and distribution engineer was the installation of more than 60,000 ft of flexible polyethylene plastic "conduit" for both primary and secondary underground distribution. According to the manufacturer's representative, who has been "researching" the job, this was the first application of this type raceway in the midwest area. Primary circuits, consisting of 5-kv, single-conductor, shielded, neoprene-jacketed cables in plastic "conduit", originated at a primary switch house adjacent to the mobile generators and terminated in a total of ten substation locations (three of them double units). Intermediate, concrete block, manholes contained grounding rods and grounding bus to which primary cable shielding was connected. Wall racks supported the cables within the 8-ft square manholes.



LOOKING DOWN THROUGH rafters of house enclosing transformer substation. Primary racks are on left, secondary bus has yet to be installed.



MODERNISTIC BRIGHTLY colored house camouflages substation for huge stage; blends with rest of display buildings.



ONE MAN pulls communication cables through flexible plastic conduit mounted to bridge deck. Note straight pull advantage provided by conduit's flexibility.



BANKS OF 20 500-watt floodlights came to job wired and mounted on platform. Electrician adjusts reflectors after connecting group to feeder. Eight such banks on building roofs spotlight main theme center.

A typical substation contained three 100-kva, 4,160/120/208-volt, single-phase, oil-cooled transformers with racked primaries and a secondary bus bar system to which secondary feeder fused disconnect switches were connected. Secondary circuits of Type TW conductors went underground in plastic conduit to various theme centers and exhibit areas. All substation equipment was enclosed in brightly colored pre-fabricated "houses" to blend with other show buildings.

For Bob Ryan, project superintendent, J. F. Fisher Company (Chicago electrical contractors) and the electricians on the job, plastic conduit was a new experience. It came to the job in coils (500-ft for $\frac{3}{4}$ -in. and 1-in.; 100-ft for 2-in. to 4-in.). The men found its light weight a distinct advantage, unrolled the coils and dropped the conduit into the trench in a jiffy. An envelope of sand protected the raceway from damage during back-filling operations. On the 500-ft runs, the conduit was cut at midpoint, a double fish-tape inserted and a splice made. Installation time for the plastic

conduits ran about one-half that required for conventional underground raceways.

External sleeve type splices served as "couplings" between coils of conduit. Both ends of the flexible raceway were butted together, the external surface painted with an asphaltum compound, and a sleeve (of next larger size conduit) slid over the joint. Strip-metal clamps over the sleeve kept the joint from separating.

Pulling cables through the flexible plastic raceways was a simple chore. In fact, most of the underground pulls were made by hand with comparative ease. Where necessary, cable lubricant was used on the longer runs and those involving numerous cables. On conduits up to $1\frac{1}{2}$ -in. size, cables were pulled in at ground level before the raceways were dropped into the trench. This meant a predominance of "straight-pulls" in large open areas without being handicapped by elbows and offsets. Even at substation locations, conductors could be pulled through the conduits at ground level before the conduit and cables were

trained up and connected to switch enclosures. Terminations of the plastic raceways at secondary switches were made effectively with standard squeeze-type connectors (normally used on flexible metal conduit). These techniques resulted in a substantial saving in cable pulling time compared to requirements of standard underground raceway systems.

Any saving in time was extremely important in a rush job of this type where work had to be done between civic events requiring the site for parking purposes. Biggest problem was the coordination of material deliveries and disbursement of more than 140 electricians at peak to keep up with construction progress, especially during the last nine pre-opening days when the major part of the main theme area was erected.

Throughout the hectic construction activity at the site, excellent coordination and cooperation between all trades maintained the tight installation schedules and the "world's fair of power" opened its doors on time on "preview night", August 30.

A CONSTANT TORQUE STARTER FOR WOUND ROTOR MOTORS

With the belt conveyor increasing in acceptance as a bulk handling medium, industrial attention is being focussed upon the resistor-reactor constant-torque starter as a means for decreasing slippage and tension.

By R. W. Egglestone, Control Engineer, Westinghouse Electric Corporation

ON MANY power drives it is desirable to have a constant torque starter on a wound rotor motor, thereby controlling the motor torque to a nearly constant value during acceleration. This is especially true on long belt conveyors, where the value of torque is chosen to protect the belt against damage due to slippage of the drive pulley and excessive tension.

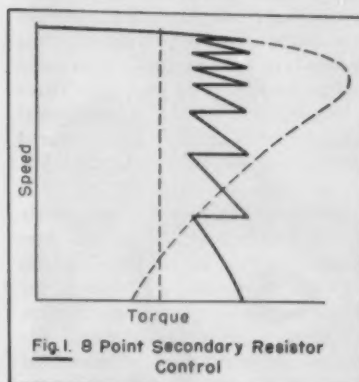
The speed torque characteristic of a wound rotor motor with a conventional eight-point secondary control (Fig. 1) illustrates the minimum

torque variation which can be obtained with eight values of secondary resistance. The vertical dotted line represents motor rated torque. For an 8-point secondary control with an average torque of 150% the maximum torque would be 170% and the minimum torque 130%. To obtain a smaller differential between minimum and maximum torque with secondary resistance only it is necessary to add additional points, thus allowing each point to cover a smaller speed range.

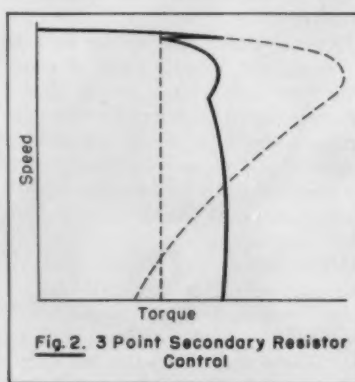
The speed torque characteristic of a 3-point resistor reactor control shows that torque of approximately 150%

power circuit of the motor primary and secondary for the first point of acceleration with resistor reactor control is shown in Fig. 4. The primary control is a single, 3-pole line contactor, thus allowing the control to be used economically with either high voltage or low voltage power supplies.

The secondary circuit provides a parallel resistor-reactor circuit between points b and d. The rotor frequency changes during acceleration and, due to the change of frequency,

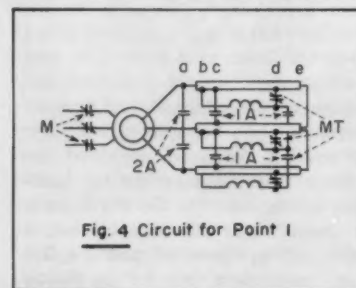
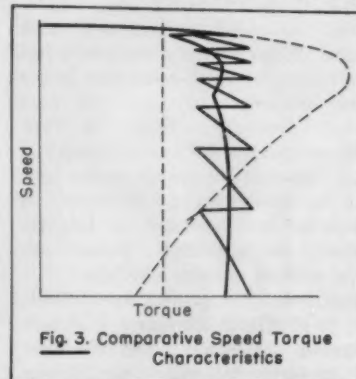


torque variation which can be obtained with eight values of secondary resistance. This speed torque characteristic is actually obtained by providing eight speed torque curves, one for each point of secondary control, and transferring from one curve to another at the proper speed. If the speed of transfer is not exactly correct, either the maximum torque will be increased or the minimum torque will be de-

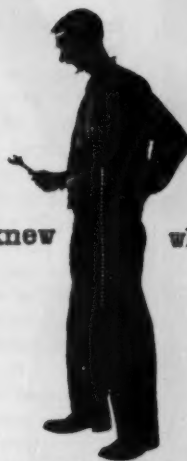


creased. The vertical dotted line represents motor rated torque. For an 8-point secondary control with an average torque of 150% the maximum torque would be 170% and the minimum torque 130%. To obtain a smaller differential between minimum and maximum torque with secondary resistance only it is necessary to add additional points, thus allowing each point to cover a smaller speed range.

If a comparison is made between 8-point conventional control and the 3-point resistor reactor control it is apparent that the speed torque characteristic of the resistor reactor control is far superior (Fig. 3). The schematic



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Constant Torque Starter

. . . Starts on page 124

this parallel circuit provides a change in equivalent series resistance and reactance. This can easily be seen by assuming an extreme change in rotor frequency of zero to infinity. For the condition of infinite frequency the reactance of the reactor would be infinity and would carry no current. Hence, the equivalent series impedance of the parallel circuit would have a value of resistance equal to that from b to d. For a zero value of frequency the inductance would be zero and all current would flow through the reactor and the equivalent impedance of the parallel circuit would be zero for both reactance and resistance.

From zero to 75% speed, the rotor frequency varies from line frequency to 25% line frequency. The frequency change for a 60-cycle motor would be from 60 to 15 cycles. Therefore, the first point of acceleration is made with a continuously decreasing secondary resistance without requiring secondary contactors to change the amount of resistance. The secondary resistance from a to b plus resistance from d to e is in series with the resistor-reactor parallel circuit and improves the shape of the first point speed torque curve shown in Fig. 5. The line current for

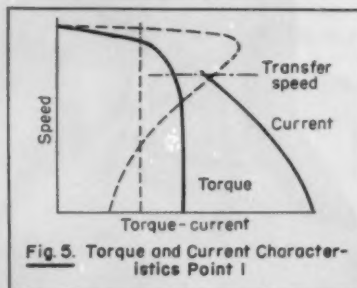


Fig. 5. Torque and Current Characteristics Point 1

the first point of acceleration is also shown in Fig. 5 with the locked current being approximately 300% for 150% starting torque and falling off rapidly with acceleration.

The circuit arrangement for point 2 of the acceleration is obtained by closing the 4-pole contactor 1A (Fig. 6). This acceleration contactor forms a star point at c for the phase resistors and a star point for the reactors at b. Since no potential exists between the star points c and d, the reactors are effectively in parallel with the resistances between points b and c. Resistance from point a to point b is in series with the new resistance-reactor parallel circuit.

The speed torque and speed current

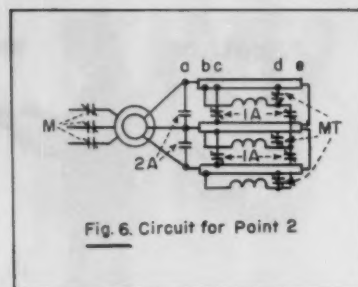


Fig. 6. Circuit for Point 2

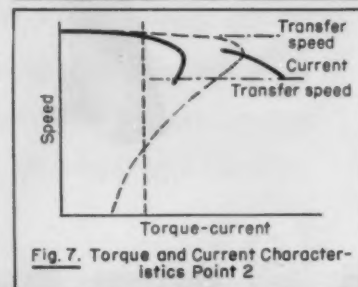


Fig. 7. Torque and Current Characteristics Point 2

characteristics of point 2 is shown in Fig. 7. The principle of controlling the torque for point 2 is entirely different than for point 1. The rotor frequency at the start of point 2 is quite small and little effect is obtained due to the change in frequency. The maximum torque of point 2 is obtained by controlling the equivalent series reactance in the resistor-reactor circuit. By again going to extreme values, it may readily be seen how resistance effects the equivalent value of series reactance.

With a value of zero resistance between points b and c no potential would exist across the reactors and the equivalent series reactance would be zero. The pull-out torque under this condition would be the pull-out torque of the motor.

With a value of infinite resistance between points b and c, all the current would flow through the reactor and the equivalent series reactance would be equal to its actual reactance. The reactor value is such that if its full value was effective, the pull-out torque would be considerably less than the desired torque. By choosing the proper value of resistance between points b and c, the maximum value of torque desired may be obtained. Resistance between points a and b determine the speed at which the maximum torque is obtained and is chosen to give the best torque characteristics for acceleration between points 1 & 2.

The third point of acceleration is obtained by closing contactor 2A which shorts the rotor and provides the running point.

A resistor reactor control of this type is now being built for a 500-hp

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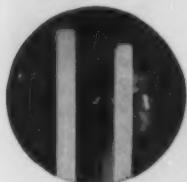
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YOU CAN BE SURE... IF IT'S

Westinghouse

Constant Torque Starter

... Starts on page 124

wound rotor motor having a 4160-volt primary. The control is for a belt conveyor at a mine. This control also includes a peak torque point with secondary circuit, Fig. 8, and torque characteristics as shown in Fig. 9. The peak torque point is obtained with contactor MT open, removing all reactance from the secondary circuit and obtaining the maximum torque curve with all resistance effective. The peak torque point in this arrangement is determined by the pull-out torque of the motor but could be reduced to smaller values by shorting out one or two of the poles on MT contactor. The current characteristic of all points in relation to speed is shown in Fig. 10, while Fig. 11 shows the torque characteristics.

The control is designed to obtain the value of acceleration torque desired, depending on the application. The maximum value for a control cannot exceed 70% of the pull-out torque of the motor. There is no limitation on the minimum torque design in respect to the motor's pull-out torque.

The resistor-reactor control is ef-

fectively a method of obtaining the desired speed torque curves and is not limited to constant torque acceleration. Curves may be calculated where it is desirable to have two values of constant plugging torques, obtained respectively on the first and second points of the master switch with four points of standard secondary resistor control (Fig. 12). This control would provide approximately 85% constant torque from 100% negative speed to zero speed on the first point plugging, and a constant torque of 125% over same speed range on second point.

A single point secondary control can be used where it is desirable to provide approximately 100% torque at 80% speed with a limited maximum torque increasing to approximately 160% torque at stall (Fig. 13).

Belt conveyors provide an economical method of handling many bulk materials and their use will certainly continue to increase. With the growing conversion of bulk handling methods to belt conveyors, the resistor-reactor constant torque starter should prove to be a valuable tool.

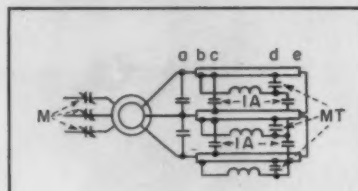


Fig. 8. Circuit for Maximum Torque Point

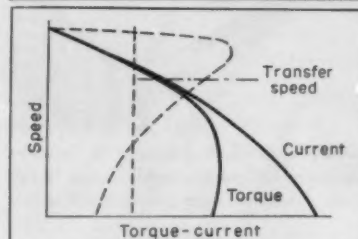


Fig. 9. Torque and Current Characteristics Peak Torque Point

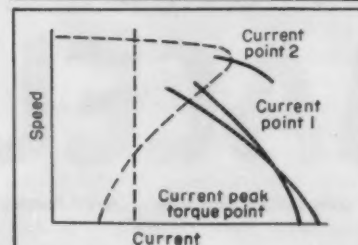


Fig. 10. Current Characteristics All Points

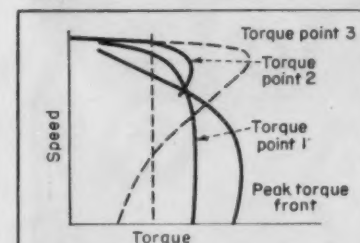


Fig. 11. Torque Characteristics All Points

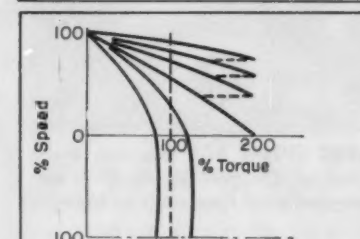


Fig. 12. Constant Plugging Torque Control

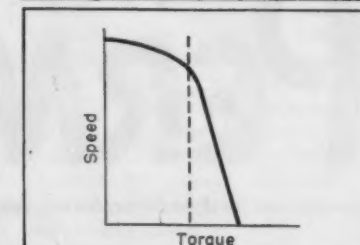


Fig. 13. Special Speed Torque Control

How to judge a fluorescent lamp ...point No. 1



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Motor Shops

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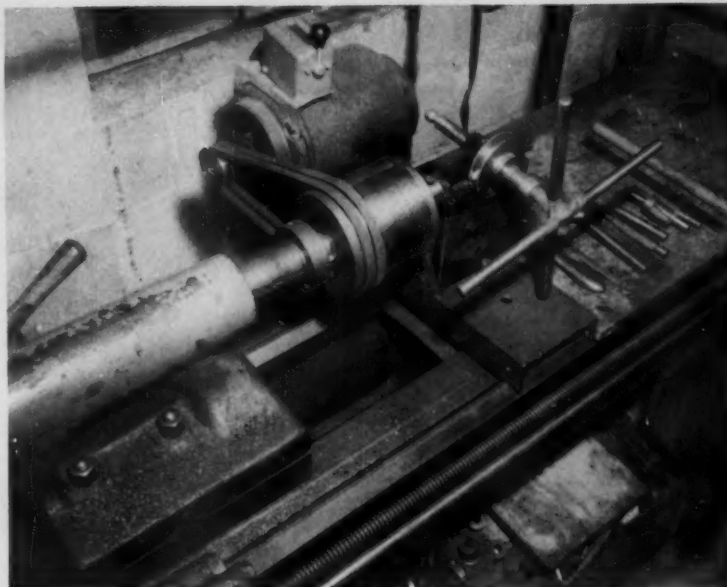
Addition of a power-driven rotating tailstock spindle to a lathe in the machine shop of Horvick Electric Motor Company, Moorhead, Minn., is boosting the accuracy of drilling operations on parts for electrically operated feed grinder hammer mills. Since this innovation, quality of workmanship has improved, production has increased and rejects are practically nil in this department. Manufacture of feed hammer mills is a successful division of the motor repair firm.

Duke Peterson, ingenious machinist at Horvick, was having difficulty with hole run-out (bell-shaped holes) while using the old method of supporting a stationary drill in the tailstock and rotating the work piece in the lathe chuck. To eliminate this, he decided to rotate both the work and drill in opposite directions. By doing this, he figured the drilling operation would be faster and much more accurate. The results proved he had the answer to the problem.

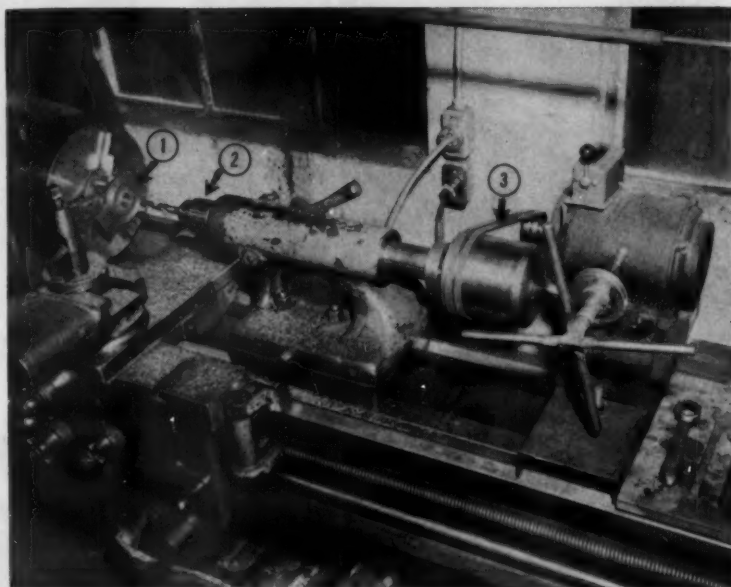
Peterson simply changed the stationary tailstock spindle to a rotating ball-bearing spindle which turns inside the tailstock quill. One end has a key-chuck to hold up to a $\frac{3}{4}$ -in. dia. drill; the other has a wide-face pulley to accommodate two V-belts on the $\frac{1}{2}$ -hp, 1200 rpm, 3-phase 220-volt spindle motor. A rack and pinion arrangement on the motor bracket moves the tailstock quill back and forth to give about a 4-in. travel to the rotating drill. During lateral movement of the drill, the V-belts ride the wide face of the spindle pulley. The motor base is bolted to the inverted channel-iron bracket mounted to the lathe bed. A "forward-off-reverse" switch controls the motor.

A four-to-one ratio between the motor and spindle pulleys provides a clockwise drill speed of about 300 rpm. At the same time, the work in the lathe chuck rotates counter-clockwise at about 150 rpm. By using this technique, a truer, more accurate hole is made in the casting being drilled. The method is also used for reaming and counterboring when required.

Application of the live spindle to this operation is just one of Peterson's many shop innovations. He also has under development a single machine on which he will be able to mill and cut keyways and knurl $2\frac{1}{2}$ -in. diameter steel stock.



POWER UNIT for live spindle is a $\frac{1}{2}$ -hp, 1200 rpm, 3-phase motor with "forward-stop-reverse" switch. Four-to-one ratio between motor and spindle pulleys provides 300 rpm drill speed. Work turns in opposite direction at about 150 rpm. Rack and pinion moves spindle laterally.



LIVE SPINDLE on lathe tailstock (2) rotates drill clockwise while work in lathe chuck (1) rotates counter-clockwise to produce a more accurate hole in casting. Dual V-belts from motor ride wide-face spindle pulley (3) to give drill about a 4-in. lateral travel when rack and pinion handle is turned.

2

NEW

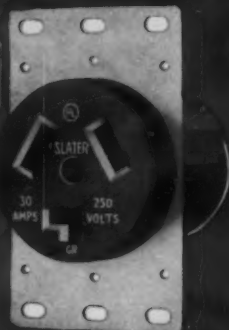
FLUSH-TYPE POWER OUTLETS FOR DRYERS

flat strap mounting speeds installation

NO. 3860 FOR SINGLE GANG BOX

features...

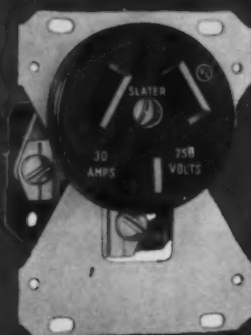
Phosphor Bronze Contacts
Clamp Elevator-type
Terminals
Patented Revolving Rear
Plate
Back Wired
Sturdy Construction
Nema "L" Shaped Slot
30 Amp/250 Volts
U/L Approved



NO. 3840 FOR DOUBLE GANG BOX

features...

Phosphor Bronze Contacts
Clamp Elevator-Type
Terminals
Easily Removable Multiple
Knockouts
Back Wired
Sturdy Construction
Nema "L" Shaped Slot
30 Amp/250 Volts
U/L Approved



NO. 734

3 WIRE DRYER CORD SET with "L" shaped slot

features...

Molded On Rubber Cap • Finger Grip Head
Extra Strong Brass Blades • Coded Conductors
Nema "L" Shaped Plate • Lengths up to 36 inches
Designed for Heavy Duty • 30 Amps/250 Volts

SEND TODAY FOR YOUR FREE COPY OF OUR
NEW 4-PAGE FOLDER ON POWER OUTLETS (Ask for Catalog #38)



SLATER

LIFETIME WIRING DEVICES
SLATER ELECTRIC & MFG. CO., INC.

Exhibit at County Show Stimulates Motor Work

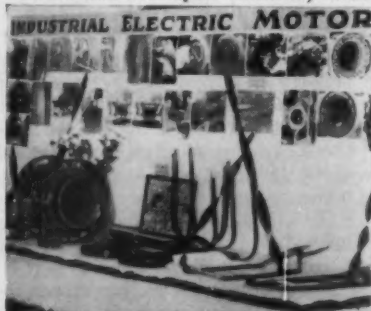
One of our national pastimes is watching other people at work. That is why crowds collect whenever noise and action accompanies "Men at Work". Sidewalk supervisors are a dime a dozen whenever new buildings are erected, and general interest always runs high whenever tradesmen demonstrate their skills in public.

This human characteristic prompted Oscar Ekblad, owner of the Industrial Electric Motors Company of Athens, Pa., to take a booth at the local Bradford County Industrial Show, and to plan an exhibit of action—with men from his shop actually winding coils and installing them in motors of various sizes and types. The exhibit also presented a variety of new motors for sale, plus samples of completed work, such as a 30-hp 550-volt coil job, a random-wound 4-speed motor, examples of sealed windings and an assortment of coils. Dozens of photographs, effectively mounted, showed unusual jobs completed in the past for satisfied customers, and bright decorations added life and color to the booth.

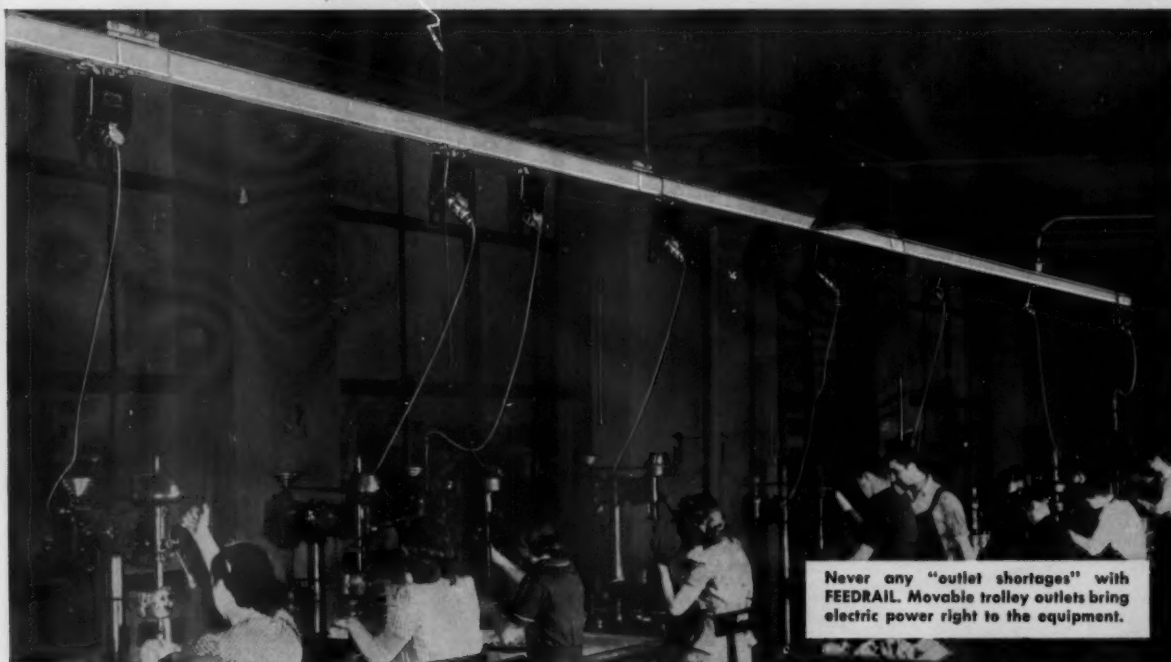
With men in action—and with pictures, samples and color all contributing to the interesting display—crowds collected to watch and ask questions. These questions (many of them anticipated) were answered by showcards, discussions, demonstrations, and informal conversations between workers and visitors to the booth.

Furthermore, since the exhibit was classed as an educational one, busloads of children from neighboring schools were urged to visit it. Maintenance men from industrial plants likewise were impressed, and farmers from the county showed keen interest in mediums for electrifying rural areas.

Results obtained by participating in this local county show were gratifying, for subsequent orders (both for new motors and for repair business) were



BOOTH AT LOCAL COUNTY SHOW
combined men in action performing typical motor shop operations, examples of motors sold or repaired, photographs of unusual jobs completed in the past, and colorful decorations for eye appeal.

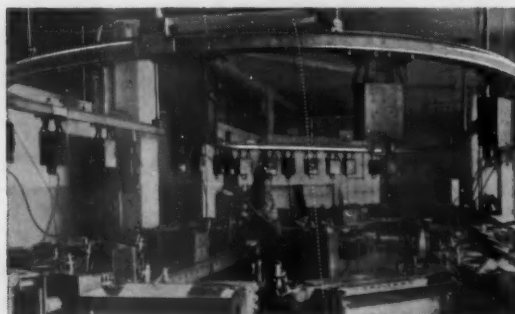


Never any "outlet shortages" with FEEDRAIL. Movable trolley outlets bring electric power right to the equipment.

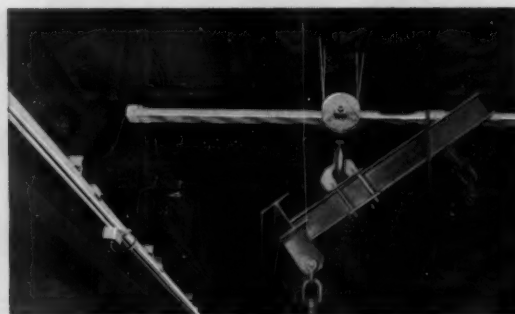
Efficiency... safety... availability make a **FEEDRAIL Electrification System a "must"**

When powering production lines, cranes and hoists, moving test lines — or as power and control circuits on mobile equipment — FEEDRAIL Trolley Busway Systems quickly pay for themselves by increasing equipment availability, providing greater operating flexibility and reducing electrical hazards and maintenance.

FEEDRAIL's free-moving trolley outlets take off power from enclosed and protected buses . . . assure a continuous, dependable current supply anywhere and everywhere the system is installed. Even when equipment is relocated or production lines changed, there will be no major shutdowns for rewiring. The entire system can be easily relocated or extended.



FEEDRAIL brings automation to test lines, making possible continuous electrical tests on equipment as it moves along the line.



No danger of accidental contact with "hot wires" on FEEDRAIL-powered cranes and hoists. Conductors are safely enclosed in sturdy steel housings.

Never Becomes Obsolete **FEEDRAIL®** **TROLLEY BUSWAYS**

Sold by leading Electrical Distributors. Representatives in Principal Cities

FEEDRAIL CORPORATION

Subsidiary of Russell & Stoll Company, Inc.

Dept. C-9, 125 Barclay St., New York 7, N. Y.

MAIL COUPON
TODAY

Please send information on FEEDRAIL TROLLEY BUSWAY Systems for:

- ☐ Cranes and Hoists ☐ Production Lines
☐ Test Lines ☐ Other Applications (please specify)

Name _____ Title _____

Firm _____

Address _____

City _____ State _____ C-9

G5-3

**FASTER... SAFER
LOWER COST
LUMINAIRE
SERVICING...**



with **THOMPSON POLE UNITS AND HANGERS**

It's easy to maintain inaccessible luminaires at peak efficiency with THOMPSON equipment. All units feature a patented mechanism that eliminates climbing and electrical hazards...makes servicing a simple one-man job.

"SERVISAFE" POLE UNITS are supplied as complete packages ready for wiring and erecting (*). Single or double-arm models and variety of new steel and aluminum poles can be furnished. BRACKET UNITS for wall and wood pole installations also are available.

THOMPSON HANGERS... for high-bay indoor luminaires... bring lights down to floor level. Variety of models and accessories permits wide range of applications.

For additional details, write for
BULLETIN WPH-54 ("Servisafe" Units)
and BULLETIN TH-55 (Indoor Hangers).

* Luminaires are not furnished in "Servisafe" packages.



AS EASY AS IT LOOKS
School custodian relamps
and cleans luminaires the
Thompson way... with
both feet on the ground.



THE THOMPSON ELECTRIC CO.

1157 POWER AVENUE

CLEVELAND 14, OHIO



WINDING OF COILS and motors attracted much interest from show visitors, and questions were numerous from industrial maintenance men, farmers, homeowners and school children. Good will in the community, plus several very acceptable orders, were the results of this participation in a community venture.

received from farmers interested in electric milking machines, hay loaders, deep-freeze units and the like; also from several industrial plants in the area (two of these having been solicited previously for several years without success). The exhibit also created considerable public interest and general good will.

As Mr. Ekblad summarized, "It was a worthwhile proposition for ourselves and the community as well. Everybody benefited; business firms, farmers, homeowners. We tied into a county-wide cooperative venture, did our share of committee work, and received our share of the general uplift in business which resulted from the Show."

Pedestal Stands

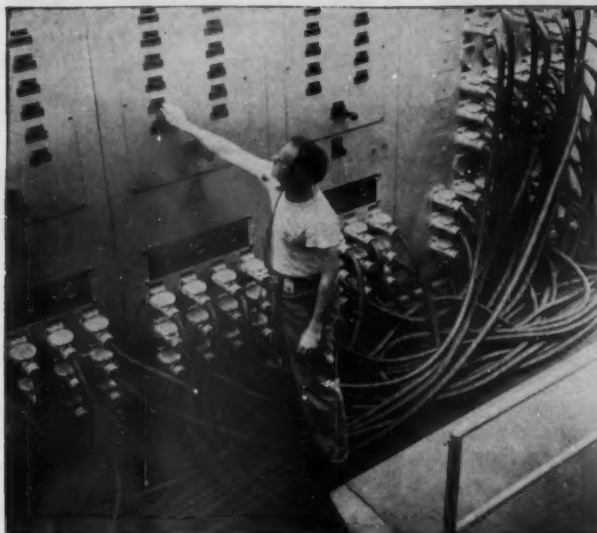
Hold Wire Reels

Reel racks formed from round base plates, tubular standards, U-shaped supporting arms and bar spindles are handy items of equipment in the shop of Berks Engineering Company, Reading, Pa. The completed units stand about 5 ft high, half of this height being available for mounting wire reels in two tiers, thereby providing for the support of four 12-in. spools, or a greater number of smaller reels if so desired.

The pedestal is formed from 3½-in. pipe, the base is 2 ft in diameter, and the entire assembly is unified by welded connections at all junction points.

Holes drilled through the vertical

SPECIFY... PYLE-NATIONAL



QUELARC PLUGS and RECEPTACLES in seventy-two foot plug board installed in the General Electric Company's Light Military Electronic Plant in Utica, New York.

PLUGS AND RECEPTACLES

For More Efficient Plant Operation

DETACHABLE COMPONENTS On any equipment that must be disconnected for inspection, repair or replacement, plugs and receptacles quickly pay for themselves by saving man hours and shortening shut-down periods. Complicated multiple conductor connections are instantly and accurately broken and remade as polarization is not disturbed.

PORTABLE EQUIPMENT Located throughout a plant at all potential operating points, receptacles for plugging in electrical tools and other portable equipment, contribute greatly to the flexibility and efficiency of plant operation.

PLUG-IN BOARDS On power distribution panels and portable generators, plugs and receptacles provide a quick efficient means of selecting and routing electrical circuits to meet the special and varying requirements of testing and research operations.



TRIPLOC*

Interchangeable and Reversible Series 250 volts, D.C.; 460 volts, A.C.; 2 to 12-poles, 15 and 20 amperes also multiple unit types 2 to 48-poles, 60 and 15 ampere combination circuits.



MIDGET TRIPLOC

Interchangeable and Reversible Series 2, 3 & 4-poles; 10 amperes, 250 volts; 15 amperes, 125 volts.



STRATE LINE*

for Hazardous Locations — Delayed Action Series 115 to 460 volts; 2 and 3-pole; 15 & 30 amperes.

*Trade Mark Reg. U.S. Pat. Off.



QUELARC*

Circuit Breaking Series 250 volts, D.C.; 600 volts, A.C.; 2, 3 & 4-poles; 20 to 200 amperes

Rugged insulation, positive polarization and grounding circuit provisions, meet strict safety requirements. Listed by Underwriters' Laboratories, Inc. Sold nationally through authorized electrical distributors. Write for descriptive bulletins.

THE PYLE-NATIONAL COMPANY

1344 North Kostner Avenue, Chicago 51, Illinois

Branch Offices and Agents in Principal Cities of the U.S. and Canada • Canadian Agent: The Holden Co., Ltd., Montreal
Export Department: International Rail Supply Co., 30 Church Street, New York

CONDUIT FITTINGS • LIGHTING FIXTURES • FLOODLIGHTS • GYRALITES • MULTI-VENT AIR DISTRIBUTION

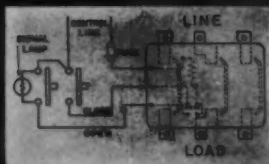


When remote control switches are specified:

THESE ADVANTAGES OF
ASCO BULLETIN 920 RC's
MEAN SAVINGS



Diagram of Bulletin 920 Remote Control Switch shows pushbutton control, built-in fuse, and signal lamp that requires no extra wiring.



Built-in fuse

No wiring for indicating lights

Use at full rated capacity

Allowable distance extremely great

Specially designed for long service

ONE source for complete line

Of particular interest to electrical contractors is the fact that ASCO Bulletin 920 Remote Control Switches have a built-in fuse that protects conductors. No need to make a separate fuse mounting to meet code requirements.

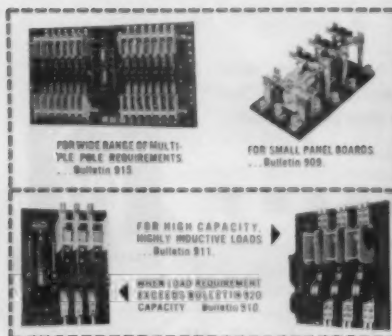
No necessity either for extra wiring to provide indicating lights at control stations. To operate the lights, the control conductors themselves may be used to carry a light load through the activating coil.

ASCO Bulletin 920 Remote Control Switches may be used right up to their ratings on tungsten, fluorescent, mercury vapor and all non-inductive loads. They have been specifically designed for these jobs.

With ASCO Switches the allowable distance between the control button and the switch is so great that it is rarely necessary to install intermediate relays with their added expense.

Users will be assured of long service from ASCO Switches because of a special design that distributes the burden of the current over two contacts. One, the arcing contact, makes and breaks the circuit while the other carries the current. This insures a high quality contact at all times. And the switches' rugged mechanical design withstands constant use.

In addition to the Bulletin 920, the accompanying illustrations show and describe other Remote Control Switches in the ASCO line. There's *one* source for a complete line of remote control switches — ASCO. Write for complete data.



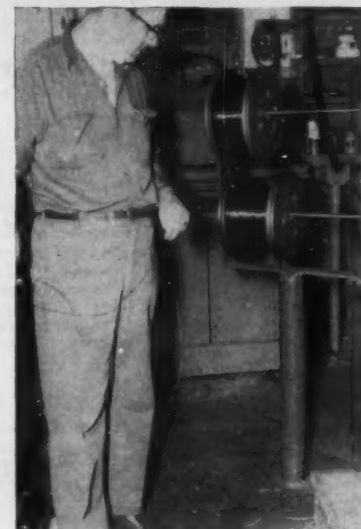
ASCO®

Automatic Transfer Switches
Electromagnetic Controls
Solenoid Valves

Automatic Switch Co.
200 E. Lakeside Avenue • Orange, New Jersey



BAR SPINDLES slide into holes drilled in the vertical arms of the stand, and each bar easily accommodates two 12-in. wire spools. Unit was assembled in the shop of Berks Engineering Company of Reading, Pa., with all connections being welded.



WIRE SPOOLS revolve freely on the tiered spindles. Round steel base makes it possible to roll the wire rack aside when it is not in use, promoting neatness in the shop and permitting easy shifting of unit from one working area to another when so desired.

arms make it possible to slide spindles in and out, while the round base plate makes it possible to tip the unit and roll it aside when it is not in use. This leaves the floor of the shop uncluttered, and the racks have proved exceptionally handy for these several reasons.

As shown in the illustrations, use of the wire rack requires only one man. He can move the rack, load and unload it and handle wire with facility and great speed.

Ask for **IDEAL**

CRIMP CONNECTORS

with the

"Wrap-Cap"

THE UNIQUE DIAPER-WRAP
INSULATOR



**STRONGER ...
BETTER INSULATED ...
EASIER TO USE!**

- Provides a Perfect Pre-Fabricated Insulating Job Every Time
- Insulates All Around Joint and Between Wires
- Puncture-Proof — Gives Double-Thickness Protection Over Wire Ends
- Insures Complete Safety — Deep Skirt Completely Covers the Bare Conductor, Even When Wires are Not Stripped Evenly



Both Sleeve and "Wrap-Cap" Insulator Listed by Underwriters Laboratories, Inc., for General use (400 V.) in Branch Circuit and Fixture Wiring.

**NO EXTRA CRIMPING
TOOL TO CARRY**

**IDEAL All-Purpose
ELECTRICIANS PLIERS**
(Patent Pending)

For use with IDEAL Crimp Connectors and all around electrical use. Crimping die makes double indentation in sleeve, increases sleeve's gripping action. New England nose gets into hard-to-reach places, twists wires, burrs conduit. Special plastic covering on handles for more comfortable grip.

* Patented, No. RE 23649 and other patents pending

Only 2 Parts...



THE SLEEVE
Patent Pending
Cadmium-plated steel sleeve makes vibration-proof, non-crystallizing, low-resistance joint, with greater holding power.

and "Wrap-Cap"
Made of same long lasting vinyl material as used on TW wire. The first insulator to insulate around and between wires. Far easier to use than tape.

**PERFECT CONNECTIONS
IN 3 QUICK STEPS**



SOLD THROUGH AMERICA'S LEADING DISTRIBUTORS
In Canada: Irving Smith, Ltd., Montreal

Send coupon for catalog data

IDEAL INDUSTRIES, Inc.



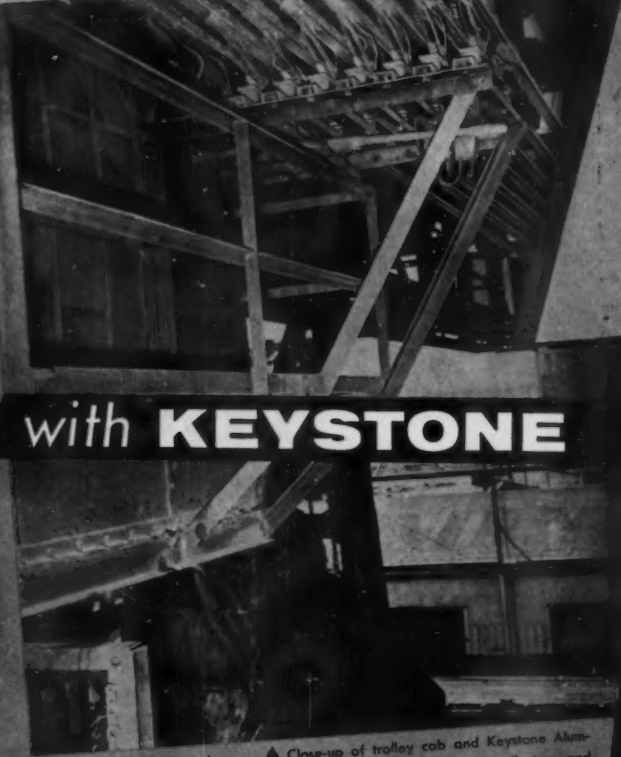
Please send catalog data on the new IDEAL Crimp Connector, "Wrap-Cap" Insulator and Electricians Pliers.

NAME _____
COMPANY _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

Unloads with **GREATER SPEED... LESS**



▲ Bird's-eye view of operations during unloading of bulk materials at Port Covington, Baltimore Harbor.



with **KEYSTONE**

▲ Trolley on Keystone Aluminum Conductor-equipped tower transfers miscellaneous bulk cargo from ship holds to waiting freight cars.

▲ Close-up of trolley cab and Keystone Aluminum Conductor System, including collectors and insulators.

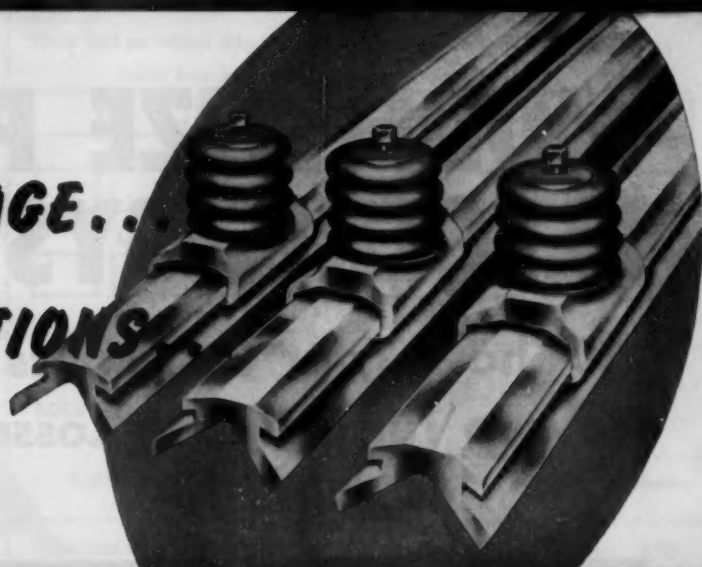


ELECTRIC SERVICE MFG. CO.

MAINTENANCE...

INCREASED TONNAGE...

FEWER INTERRUPTIONS



Integrated Aluminum Conductors

at Western Maryland Railway

FASTER, more economical handling of ore and other materials has resulted from replacement, with a **KEYSTONE** Integrated Aluminum System, of all old trolley conductors on the double-apron unloading tower at the Western Maryland Railway docks at Port Covington, Baltimore Harbor.

SPEEDY CARGO TRANSFER from ship-to-shore is important in getting highly competitive ore-unloading business along the Eastern Seaboard. Ship operators want fast unloading, to give them quick ship turn-around . . . less time for ships in port . . . more time for profitable cargo-carrying.

TO SPEED turn-around, Western Maryland Railway modernized its facilities by replacing old copper and steel conductors with Keystone aluminum a year ago. Benefits resulting from it are:

Higher Speeds . . . no longer a need to "trolley" at low speed to avoid breakdowns; greater efficiency in power conductor gives unloader more "pickup" capacity.

Fewer Work Stoppages . . . new conductors eliminate frequent breakdowns and derailments.

Greater Tonnage . . . from overall greater efficiency; more ships now unloaded without proportionate increase in cost.

Cheaper Maintenance . . . due to fewer conductor breakdowns while unloading; upkeep reduced to regularly scheduled, less costly preventive maintenance. Equipment burnouts sharply reduced.

***Why* THE KEYSTONE INTEGRATED ALUMINUM CONDUCTOR SYSTEM GIVES LONGER, BETTER SERVICE**

Durable—Aluminum lasts longer in destructive atmospheres. Contact surfaces stay smoother and cleaner than steel . . . prolong shoe life. Multiple contact collectors prevent arcing and heating. Less vibrating weight saves insulators.

Lightweight—Permits prefabrication of units, to reduce cost of installation, insulators and supporting structures. Compact design saves space, permits better protection with standard enclosures.

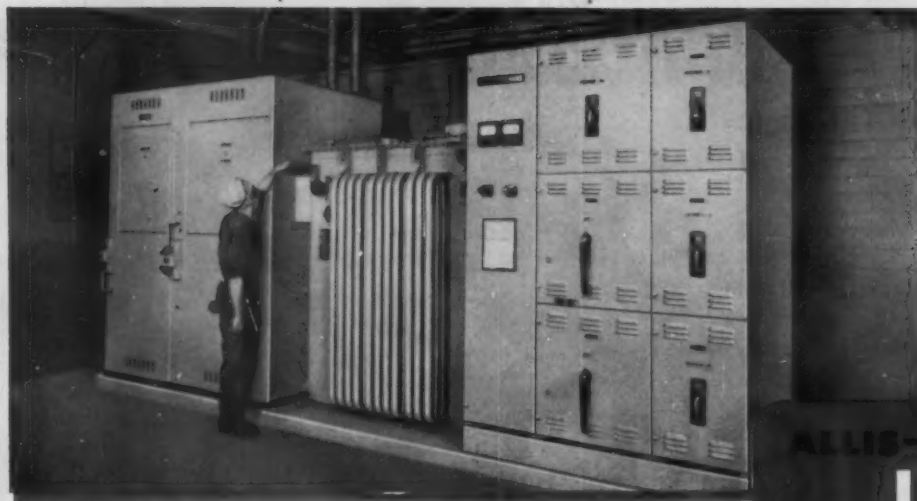
Voltage and Capacity—Non-magnetic aluminum increases current capacity through lower reactance, and permits closer conductor spacings. Ample capacity for other equipment without need for boosters or multi-point feeds. Pre-engineered systems now operating to 6000 amp capacity.

Write today for Booklet 439 on Keystone Integrated Aluminum Conductor Systems.

Philadelphia 32, Pa.

MODERNIZE PLANT ELECTRIC SYSTEMS

... Show Your Customers
How to Turn Hidden Losses
into PROFITS!

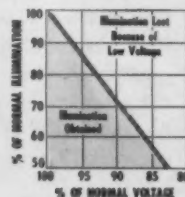
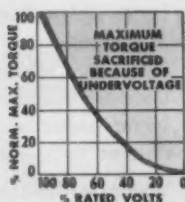


Flexible, compact units fit into any plant. Allis-Chalmers unit substations can be mounted anywhere. Tuck them into a corner of the production floor, mount them on balconies, in the basement, on the roof, or outside the building. Metal enclosures eliminate need for vaults and provide attractive appearance.

ALLIS-CHALMERS
UNIT
SUBSTATION

Charts Show Losses

when voltage is low. Upper, torque loss at machines. Lower, illumination lost. Placing unit substations at load centers shortens low voltage cable, improves voltage, and makes future changes simpler, less costly than with many outmoded plant arrangements.



Outmoded or inadequate plant electrical systems steal profits. When voltages are low you lose in machine and operator efficiency. Dim lighting cuts inspection and assembly efficiency. Addition of new machinery to plants with older systems frequently causes extra expense for long secondary wiring.

Solve the problem with modern Allis-Chalmers unit substations. Full power is distributed from the center of load. Voltage drop and conductor losses are kept to a minimum. Expensive secondary wires to equipment are short and flexible — it is easy to make changes at little expense.

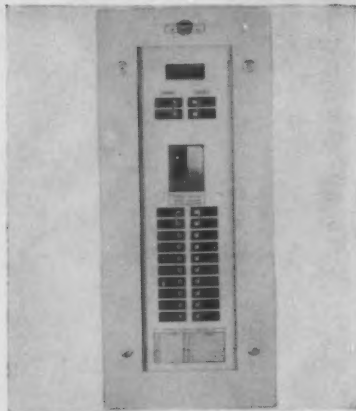
Let experienced substation engineers help solve your distribution problem. Call your nearby Allis-Chalmers district office. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, for your copy of "Power at Load Centers Pays Off."

ALLIS-CHALMERS



A-4740

Product News



Panelboard

(1)

A new home panelboard, the Circuitrol, is specifically designed to appeal to the home owner's need for an all-in-one, built-in, home power center, while also providing an extra margin of capacity for future electrical needs. Unit provides 20 to 42 branch circuits for 100- or 200-amp entrance service sizes. It is available in seven models for either single phase 3-wire or 3-phase 4-wire service. Single pole "plug-in" type EQP circuit breakers protect branch circuits, are quick-make and quick-break on manual, quick-break on overload operation. Several models have service entrance sections containing two to four 2-pole breakers for major appliances. Tie-bars are furnished where additional 2-pole breakers are needed. Units are approved by Underwriters Laboratories. They may be flush or surface mounted. Catalog is available.

Continental Electric Equipment Co., Box 1055, Cincinnati 1, Ohio



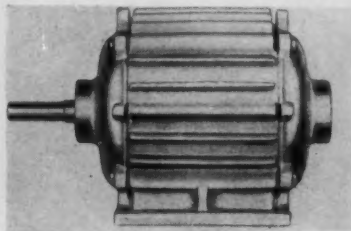
Floodlight

(2)

A new outdoor floodlight that allows lamps to burn cooler has been developed for heavy-duty use. Weathertight, rust- and corrosion-proof, the floodlight (Cat. No. 40-L) is designed to eliminate back-light halo and to give lamp full protection while permitting circulation of cooling air. Developed for all-weather use, particularly in face up position, unit features "Cushion-Seal"—a high-temperature, live

silicone rubber weatherseal that hugs lamp in a cushioned rubber grip to seal it from moisture and protect it from shock. Cast aluminum housing is mounted on an adjustable swivel arm that locks in position with intergripping teeth. Approved by UL, floodlight is available with narrow and wide beam lamps for all floodlighting and spotlighting applications, with wiring troughs, splice boxes and other interchangeable fittings for multi-unit floodlighting assemblies, and in cord-equipped units for portable use. Bulletin 138 is available.

Stonco Electric Products Co., 333 Monroe Ave., Kenilworth, N. J.



Motors

(3)

A new line of totally enclosed fan-duty motors, designated as Type EFD, in ratings of $\frac{1}{2}$ - to 20-hp, especially designed for industrial and commercial use. Features include: double-width prelubricated sealed ball bearings; deep, integrally cast fins; "extra-margin" windings have double-heavy formvar wire; optional connection boxes to fit any air-over-motor application. For installations requiring explosion-proof construction, motors are built in a Type EXFD which is approved by UL for use in hazardous locations of volatile gases and explosive dusts.

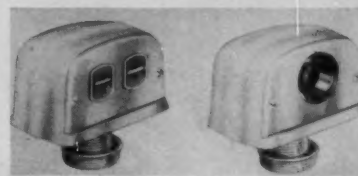
Lima Electric Motor Co., 33 Findlay Road, Lima, Ohio

Hydraulic Lift

(4)

A new, multi-purpose, mobile hydraulic lift, known as the "Bulb Snatcher". It lifts both men and materials up to 400 lbs. in weight to a height of 20 feet above floor level. Unit can be raised and lowered from its rail guarded 24-in. diameter platform or from the floor. A 35-ft Neoprene covered 3-conductor cable conveys the power for the 110-volt electrical system. Unit consists of a rigid frame supported by three 12-in. wheels; forward wheel being attached to a tow bar for steering. Swiveling rear wheels have locks that hold them straight and foot brakes are supplied. When not being operated it is 30 in. wide and 6 ft 5 in. high. Literature is available.

G. W. Galloway Company, 25 N. 4th Avenue, Arcadia, Calif.

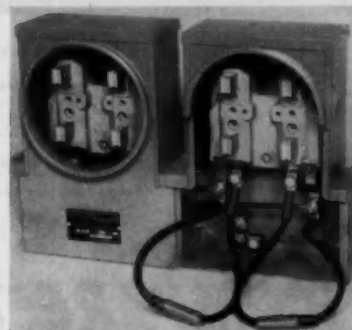


Service Fittings

(5)

Minimum housing height features this new line of service fittings for high potential wiring. The line, equipped with standard receptacles, is less than three inches high and is especially designed for installations where height is restricted by desks or free-standing equipment. Coupled with underfloor wiring systems, the satin finished die-cast aluminum fittings match well with modern desk trim and office equipment. Ample wiring capacity is provided by a 1-in. nipple from duct to fitting. The new combination Nepduct or header duct service fitting line is available with six different receptacles. In addition to the standard T-slot receptacle, all standard 2- and 3-wire receptacles are available.

National Electric Products Corp., Gateway Center, Pittsburgh, Pa.



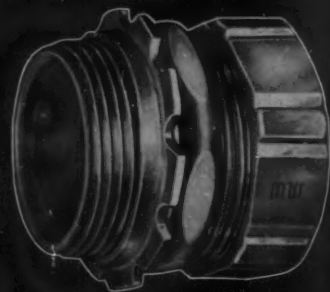
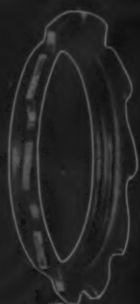
Socket Meter Mounting

(6)

New socket meter mountings provide continuous service to the customer while meter is being removed or tested. Ample wiring room is provided and there are no wires behind meter to cause shorts or ground. Water or condensation cannot get on any wires behind the meter as bus bars back of porcelain bring wiring terminals into lower section, or channel, of the mounting. This mounting can be used as a single unit and additional mountings may be added at any time without fittings by removing end wall of each mounting as mountings interlock onto one another. Mountings are also made in small size single unit with or without hubs in top. Construction is of aluminum or galvanized steel. Literature is available.

Code Products Corp., 214 Kalos St., Philadelphia 28, Pa.

MW



• Multiple locking edges for greater bond. Assures positive ground for electrical system.

• Reverse bevel on inner surface permits bonding edges to be pulled up tight to locking surface.

• Spring tension against locking surface provides permanent shake-proof installation.

• Up to 66% more driving notches for easier working angle, when tightening.

• Heavy gauge steel. Cadmium plated for corrosion protection.

COMPARE THESE *midwest* LOCKNUT FEATURES...

These "Sure Bond" Locknuts are specifically designed to do a better job. Compare these features against those of other types of locknuts. All Midwest fittings, 2" and smaller, come equipped with "Sure Bond" locknuts.

★ Here is another Midwest development in providing quality fittings. "Quality" is just a condensed way of saying: "Getting the total job done—right—with the most inexpensive combination of material and man hours." Engineering and producing quality fittings to meet the highest standards of electrical wiring installations, is our objective at Midwest.

Midwest Electric Mfg. Company

MANUFACTURERS OF ELECTRICAL WIRING PRODUCTS

1639 W. WALNUT STREET

Chicago 12, Illinois



Load Center (7)

A new circuit breaker load center, with 20 circuits arranged in a split-bus interior design, was specifically developed to cope with the problem of adequate wiring in the highly electrified modern home. Device is equipped with 100-amp main lugs, and is listed by Underwriters' Laboratories Inc. There is available in the service section five double-pole branches for 240-volt electrical devices. A sixth double-pole branch feeds eight more single poles in the split section of the bus to provide ample circuits for lights and 120-volt appliances. Because the number of operating handles in the service section can be limited to six, the new load center is suitable for use as service entrance equipment without a separate disconnect in compliance with NEC requirements. Unit is available with fronts for either surface or flush mounting. Load center will accommodate G.E.'s new Type TQL 2-pole common trip circuit breakers for double-pole circuits, as well as Type R circuit breakers for single-pole branches.

Trumbull Components Department, General Electric Co., Plainville, Conn.

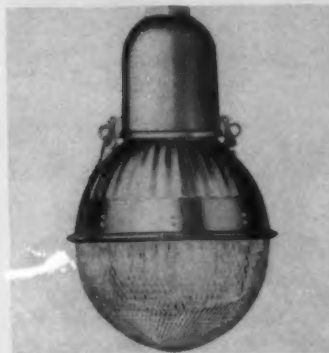


Light Conduit (8)

Designed to light the interior of metal tanks and kettles, this Type V observation light conduit permits visual inspection through observation windows of food contents during processing. Heat-resisting glass globe eliminates breakage, and food loss from glass particles. Observation light is vaportight. For use with 50-, 60-, 75- or 100-watt lamps, the flanged globe is furnished with an asbestos gasket which seats in the mounting ring, the supporting unit of the fixture. A clamping ring

secures globe to mounting ring. Mounting ring is provided with rivet holes for insertion in tank, or may be welded or brazed to tank. The conduit body, with threaded hub and composition lamp receptacle, is attached by two thumb screws to globe clamping ring. Unit must be connected by flexible cord, conduit or couplings so body can be removed for relamping.

Crouse-Hinds Company, Wolf and Seventh North Streets, Syracuse, N. Y.



Luminaires (9)

Spherulite luminaires are now available with L-M's new refractor that provides an IES Type II 4-way offset light distribution pattern. They are used for intersection lighting where direct pole mounting is desired. Unit will accommodate up to 10,000-lumen incandescent lamps. Refractor is interchangeable with existing refractors in all L-M spherulite luminaires, whether they have either V-band clamping or pressure, automatic, or wing-nut latching. Units are also available with globes and refractors for Type I, II, III, IV, V and Type I 4-way light distribution patterns.

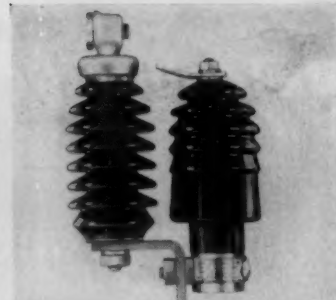
Line Material Company, 700 W. Michigan St., Milwaukee 1, Wis.



Sign (10)

A new directional sign with downlight, Model 205, has a plastic bottom shield which provides general illumination and makes possible quick access to wiring for maintenance. Rounded housing has fluted front and sides, measures 6 1/4 in. by 16 in. by 4-in. Signs are available in white with red letters, red with white letters, white with green letters and green with white letters; letters are 5 in. high. Fixtures are U.L. approved. Catalog is available.

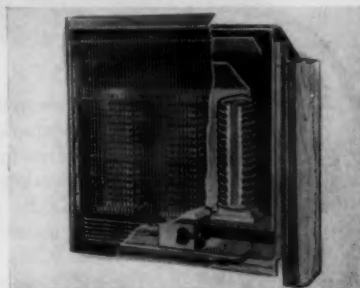
Atlas Electric Products Co., 315 Ten Eyck St., Brooklyn 6, N. Y.



Lightning Arrester (11)

A new type of expulsion arrester, with a spiral grooved expulsion chamber. Features are—discharge arc is effectively controlled throughout entire operating cycle; low sparkovers are obtained; multiple arcing paths minimize fibre erosion; high strength construction and good venting provide high lightning surge capacity. Arrester is both mechanically and electrically isolated from live line parts. It is available in 9 and 18 kv design and will be provided on all RT & E-protected type transformers. Also available in conversion assemblies and crossarm assemblies. Bulletin 6000 is available.

RT & E Co., 1900 East North St., Waukesha, Wis.



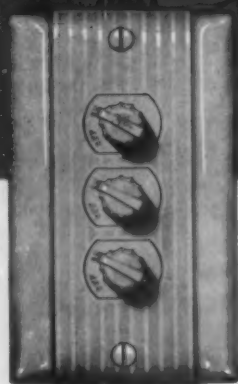
Space Heaters (12)

A new line of wall-unit space heaters. The specially compounded ceramic cones which support the nichrome heating coils are of a modified delta shape. This delta cone releases heat rays at angles which reduce entrapment of heat. The aluminum grille is large enough to permit easy passage of heat but small enough to prevent fingers or other objects from touching the heating coils. Finger slots are provided at top to facilitate removal of grille for cleaning. Lip-slot louvers conceal thermostat housing and interior wiring while providing free exposure of thermostat bulb to room temperature air. Grille perforations are continued at bottom of heater. Heaters are produced in 11 models with from 1000- to 4000-watt capacity. All frames are finished in grey hammertone, with aluminum grille. Single cone models are available with chrome grille and frame for bathroom use.

Ceilheat, Inc., 5212 Homburg Drive, Knoxville, Tenn.

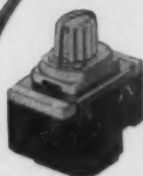
for quality wiring jobs

with a modern touch



ROTO-GLO
quiet switches

because switches should be seen . . . not heard!



Despard Type
15 Amp., 120
Volts AC,
277 Volts AC



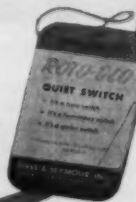
Type
15 Amp., 120
Volts AC

With modern ROTO-GLO Quiet Switches your most inexperienced help can make quality installations in a fraction of the time required to install other types. And the totally enclosed plastic body and non-oxidizing silver alloy contacts assure years of trouble-free operation.

You make more money on ROTO-GLO quality installations and satisfied customers like the whisper quiet operation and the luminous knobs that glow in the dark.

ROTO-GLO Quiet Switches turn off and on like a modern radio or TV switch. They are available in both P&S Despard type for modern combination wiring, and conventional strap type to provide quiet switches for the replacement market and for new work.

ROTO-GLO identification tags tell everyone that you've used the finest switches available. It also reflects quality workmanship. For complete details write Dept. RC-22.

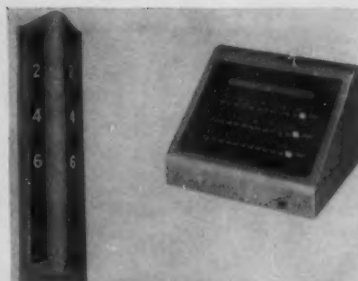


P&S

PASS & SEYMOUR, INC.,

Syracuse 9, N. Y.

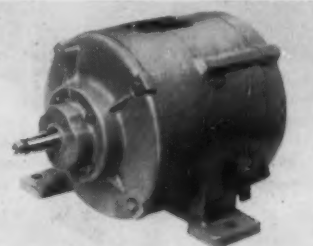
71 Murray St., New York 7, N. Y.
1229 W. Washington Blvd. Chicago 7, Ill.



Paging Annunciator (13)

A V-shaped doctor's paging annunciator with two illuminated surfaces that can be seen from three directions. Unit can be mounted on walls at "T" corridor intersections or may be used for a double faced ceiling annunciator. It eliminates necessity for triple-faced annunciators. Replacement of lamps in unit is simplified by a removable "egg crate" bulb separator which lifts off leaving bulbs free. The unit comes equipped with bulbs and is stencil marked from 1 through 0. It also has a chime and cut-off switch. Additional equipment available includes a fire alert red bullseye or a special red corridor dome which can be mounted adjacent to the annunciator.

Auth Electric Company, Inc., 34-20 45th St., Long Island City, N. Y.



Loom Motor (14)

A new, conventionally designed clutch-brake loom motor which helps provide constant picking speed, fast and more accurate braking, reduced speed fluctuation, and low maintenance costs. Rotor is pressed onto heavy flywheel which provides the inertia for smooth loom operation. When a warp thread breaks, a clutch automatically disengages from the flywheel and rotor, thus removing inertia and brake brings loom to a stop. Insulation of clutch-brake motor is of polyester film.

General Electric Co., Schenectady 5, N. Y.

Heater (15)

A new ceiling radiant heater, Heetaire (Series 280) is designed with "Even Heat" distribution and with an exclusive "Plug-In" Installation. The "cherry red" radiant heating element is completely sheathed in a special nickel chromium alloy that arrests moisture action, and is completely suspended. It is 12½ in. from edge to edge and available in 1000 watts

(model 281) and 1250 watts (model 282). It is a matter of minutes to fit the pre-wired housing between standard 16-in. joist centers and pull regular house wire into the junction box for splicing. Heating unit can be plugged in after the ceiling is finished. Other features include thermal overload safety control, Nichrome flush rim, silent fan, plaster flange adjustable flush to 1-in., built-in outlet box with eight knockouts.

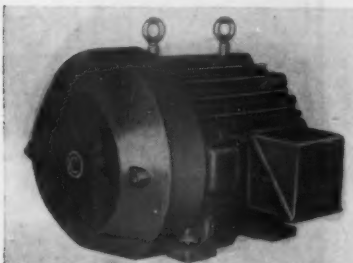
Markel Electric Products, Inc. and La-Salle Products, Inc., Buffalo, N. Y.



Fluorescent Fixture (16)

A new shallow luminaire featuring plastic sides and plastic louvers, is known as the Cleer. It is more than 14 in. wide and 4 in. deep. Unit is recommended for low ceiling installations in modern stores, offices, schools and institutions. Translucent extruded polystyrene side panels permit a soft diffusion of light outwards. Top reflectors for 100% downlighting are available on special order. Unit is available for two or four rapid-start bi-pin lamps in 4- and 8-ft lengths and for two or four T-12 slimline lamps in 8-ft lengths.

Smithcraft Lighting Division, Chelsea 50, Mass.



Motor (17)

A new rerated totally enclosed fan cooled motor line in the 7½ to 100 hp series. In addition to meeting all NEMA requirements, new line has such features as "six layer insulation" for stator winding using plastics and plastic coated wire; a ventilating fan providing same efficiency of cooling when operated in either direction; rib type cast iron frame construction. They are recommended for use in dirty, dusty, fume and mist-laden atmospheres.

Century Electric Company, 1806 Pine St., St. Louis, Mo.

- **SCREWLESS TERMINALS**
- **DOUBLE GRIP CONTACTS**



HIGHER PROFITS

There's a bigger profit margin on both small and large jobs with low-priced P&S 1500 Outlets. On the job, and laboratory tests have proven that savings on installation time alone average 4-5¢ per outlet. Long-lasting, trouble-free performance saves "bad connection" call backs.

LONGER LIFE

P&S double phosphor bronze spring contacts exceed "pull" requirements of Underwriters' Laboratories, Inc. They hold cap blades in a grip that can't loosen by vibration. Perfect long line contact, with minimum heat, assures years of dependable performance. And the back of the P&S 1500 is completely insulated for extra safety. Meets Federal Specification W-R-151-a.

Just 2 fast steps:



Strip wires . . . using the handy strip gauge molded on back of outlet for guide.



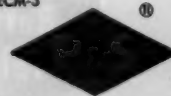
Insert wires in wire holes. One firm push securely anchors the wires.

TO REMOVE WIRES insert an 8 penny nail in center hole on either side. Spring is released and wires come out easily.

Write today for a free P & S catalog on the new 1500 Outlet to Dept. ECM-3

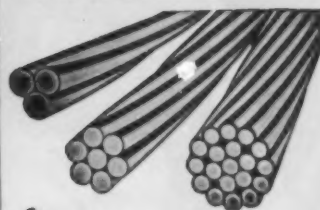
PASS & SEYMOUR, INC.,

Syracuse 9, N. Y.
71 Murray St., New York 7, N. Y.
1229 W. Washington Blvd., Chicago 7, Ill.



ACCO
Quality

PAGE Stainless Steel Strand



for Severe Service Conditions

PAGE Stainless Steel Strand is equally versatile for ground, guy and catenary applications. Its higher tensile strength, corrosion-and-abrasion resistance, elastic limit and strength-to-weight ratio make it your first choice! Its lower cost per year of use means long-range economy.

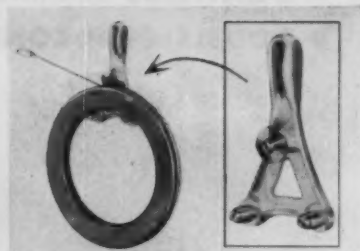
Write us at Monessen, Pa.,
for complete information

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San Francisco, Bridgeport, Conn.

PAGE STEEL AND WIRE DIVISION

AMERICAN CHAIN & CABLE

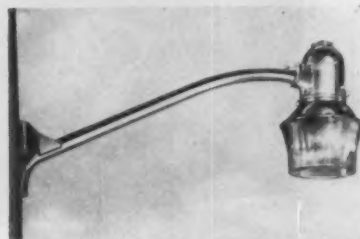
for
Better
Value



Fish Tape Winder (18)

A new fish tape winder which attaches to any Ideal fish tape reel. As the winder handle is pulled around the reel, a wheel spreads the reel housing and allows the fish tape to wind or unwind. Double rollers traveling around the inside diameter of the reel hold the winder firmly in place as it is rotated around the reel. Available in three sizes to fit all Ideal fish tape reels.

Ideal Industries, Inc., Sycamore, Ill.



Luminaire (19)

New open refractor luminaire has been designed primarily for either the 100- or 175-watt mercury vapor lamps. Incandescent lamps through 5000 lumens can be accommodated also. Unit is used, but not exclusively, for application in residential areas. Refractors provide either IES Types I, II, III, or Type II 4-way offset light distribution patterns. An alzak aluminum reflector, having a diffusing surface, is used for mounting open refractor to L-M's standard NEMA large head. Pressure latches insure positive attachment of reflector to head. A V-band clamp is used that simplifies replacement of glassware.

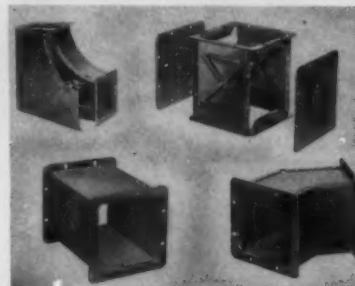
Line Material Company, 700 W. Michigan St., Milwaukee 1, Wis.

Mobile Power Unit (20)

"Mo-Bil-Ac" is a new portable source of ac power which delivers up to 10 kw at 110 and 220 volts and extends the use of power tools and motor driven machinery in locations away from power lines or during power failures. Unit supplies ac at commercial voltages and frequencies, single or polyphase. The 2-pole alternator, which forms one half of the 2-part unit, may be mounted under the vehicle hood and driven by a V-belt from a sheave on crankshaft in front of fan pulley, or by a power take-off. The other half of the system is the regulator, a static unit of magnetic amplifier type with a selenium

rectifier to provide alternator excitation. Units rated at 3-, 5- and 10-kw are in production.

Star-Kimble Motor Div., Miehle Printing Press & Mfg. Co., 200 Bloomfield Ave., Bloomfield, N. J.



Fittings (21)

A complete line of auxiliary fittings are available for use with 8-in. by 8-in. flanged square wireways. Fittings added to the line include 8-in. by 8-in., 90° elbow and pull boxes, 7½°, 22½° and 45° elbows, junction boxes, trough collars, bracket and drop hangers, closing plates and reducing bushings, as well as 1-, 2-, 3- and 6-in. nipples. All fittings are brake formed from heavy gauge steel, and feature precision formed edges for easy assembly with wireways. All units are finished in gray enamel for corrosion resistance. Literature is available.

Keystone Manufacturing Co., 23328 Sherwood Road, Center Line (Detroit), Mich.



Clock Outlet (22)

A new outlet specially designed for use with electric clocks has deep recessed back for cord. In use, the outlet holds the clock on a cadmium plated steel hanger, and is completely concealed from view. Clock hanger outlet, No. 1480, is of one-piece molded Bakelite construction and has spring bronze double-wiping contacts. Unit is available in brown or ivory, and is listed by U. L. Rating is 15-amp, 125 volt; 10-amp 250 volt.

John I. Paulding, Inc., New Bedford, Mass.



Will the homes you wire provide the convenience and satisfaction of telephone outlets in all the right places with wires concealed? There's one way to be sure—include telephone conduit in your contracts.

Your Bell telephone company will be glad to help you work out economical conduit installations. Just call your nearest business office and ask for *Architects and Builders Service*. For details on home telephone wiring, see Sweet's Light Construction File, 8i/Be. For commercial installations, Sweet's Architectural File, 3la/Be. **BELL TELEPHONE SYSTEM**



2000 POUND HOPPER CAR JUMPS TRACK...

RAWLPLUGS HOLD IT IN MID AIR SAYS 10 YEAR USER OF RAWLPLUGS

"The height of the pictured stack was 180 feet. The hopper to the right of the stack was in operation and somehow the hopper car wheel became entangled in the rope from the top of the scaffolding. The hopper car, weighing several thousand pounds was suspended freely in the air but in spite of this, the Rawlplugs held.

"It was one of those unusual conditions, adding greatly to the stress on the scaffolding and the Rawlplug fastening. We were using $\frac{1}{2}$ " x $2\frac{1}{2}$ " Rawlplugs with $\frac{1}{2}$ " x 4" lag screws to hold a rigid arm fastened to the brick masonry and then bolted to our vertical frame.

"We have used Rawlplugs with lag screws for these fastening operations for at least the last ten years. The safety of the workmen, as well as movement of supplies, is dependent upon our safely and securely mounted scaffoldings.

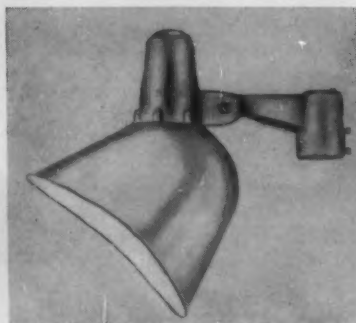
"We like Rawlplugs for our fastenings because they give us a sure and dependable anchorage and have shown us their ability to withstand those unusual conditions that can occur on a construction job."

F. V. LaMarca
ADJUSTOMATIC SCAFFOLD CO.
of PITTSBURGH

Write for catalog and prices.



THE
RAWLPLUG Co., Inc.
271 Church St., New York 13, N. Y.



Floodlights

(23)

New pole top mounted Series 6000 floodlights are equipped with a newly developed combination cast aluminum neck and mounting arm. This component has built-in pole slip fitter, weatherproof adjusting joint and wiring compartment for fully enclosed wiring. Provision is also made for mounting standard outdoor type ballasts for 400-watt mercury vapor lamp installation. Units are available with either elliptical or parabolic reflectors. Elliptical types may be either porcelain enamel or spun aluminum. Parabolic reflectors are spun aluminum either open or enclosed, narrow beam or medium beam. 300 to 1500-watt incandescent or 400-watt mercury vapor lamps may be used.

Steber Manufacturing Co., Broadview, Ill.



Service Head

(24)

A new slip-fitter service entrance head. Instead of threads or separate clamp parts or adapters, the head has two set screws. Main housing frame is set on rigid conduit and held by tightening set screws. Because it does not have to be screwed on, it can be attached to installed conduits which are close to walls. Currently available to fit 1½-in. conduit, the new head will soon be sold in all sizes.

Blackhawk Industries, Dubuque, Iowa

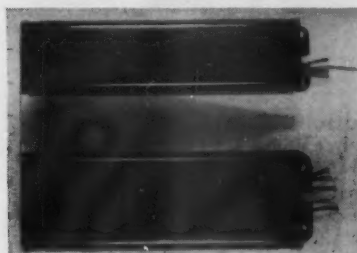
Switch

(25)

A new low-force heavy-duty limit switch, which can be operated with 2½ ounces of force, is designed for use on counting devices or similar applications. Switch's actuating lever is a 5-in. aluminum rod, ¼-in. in diameter, which can be bent or cut off to fit user's needs. Operation can be clockwise or counter-clockwise. A 60° overtravel permits use in applications where operating motions

cannot be accurately controlled. Switch is available in either of two contact arrangements. One, designated 1ML10, is single-pole double-throw and the other, 101ML10 is 2-circuit break. Both are listed for 10 amps at 120, 240 and 480 volts.

Micro Switch, Freeport, Ill.

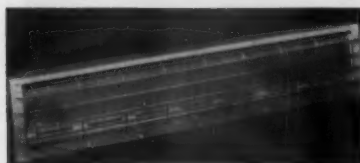


Lamp Ballast

(26)

A new, rapid-start, fluorescent lamp ballast incorporates a unique new core shape. This has resulted in a 28% smaller cross-section and a weight reduction of 1½ pounds. The new C.B.M. certified ballast is constructed in the narrow brickette cross-section, while retaining the short length of the brick-type ballast. This model has the same center mounting dimensions as the one it supersedes. An additional lead has been added to the ballast, so that it can be connected directly to the lamps. It is a high power factor model designed for use with two 40-watt rapid start fluorescent lamps. Sound rated B for use in installations such as classrooms, churches, and quiet offices, it has a circuit voltage of 110-125 volts, minimum line power factor of 90% and line current of .85 amps.

General Electric Company, Schenectady 5, N. Y.



Baseboard Heaters

(27)

New electric radiant glass baseboard heaters are designed for heating a whole house or a room, as required. It can also be used for supplementary heating of a "hard to heat" room. A thermostat in each room ensures regulation of temperature. The baseboard panels fit against the wall in lieu of baseboard, and are fastened in place by screws. The panel is 2½ in. deep, including outer guard. Joining and corner sections match the panel ends and make it possible to extend baseboard panels in an uninterrupted line along two or more walls. Blank sections may be cut to provide an exact wall-to-wall fit for any size room. Provision is also made for an ample number of duplex electrical outlets, as desired, between the 36-in. long panels.

Berko Electric Mfg. Corp., 212-40 Jamaica Ave., Queens Village, N. Y.



PRESSURE PLATE BACK WIRING FOR GREATER WIRING SECURITY, SAFETY AND CONVENIENCE



Diagram at right shows how the Hubbell pressure plate mechanism is designed. The stripped wire, when inserted through the reinforced back wiring holes (left), locates between the two terminal plates which, as the screw is tightened, pressure-grip the wire securely (picture below).

the convenience
of modern
back wiring

plus

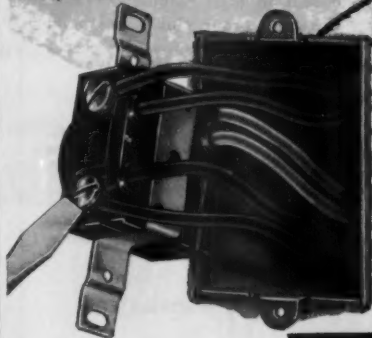
the
safety

of a
pressure plate
screw connection

Save-A-Splice . . .

Another important advantage of Hubbell pressure plate back wiring is the fact that a circuit may be extended using both back and side wiring. The same binding screw anchors both the wire inserted through the hole in back and the side-leaped wire.

Twist-Lock
No. 7582



*Highest
Grade*

HEAVY DUTY

WIRING



DEVICES

23HH55A

HARVEY HUBBELL, INC.

DEPT. C-1

BRIDGEPORT, CONN.

FACTORY WAREHOUSE LOCATIONS ASSURE NATIONWIDE STOCK AVAILABILITY

State and Bestwick Sts.
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37 South Sangamon St.
Chicago 7, Ill.

103 North Santa Fe Ave.
Los Angeles 13, Calif.

542 Metoma St.
San Francisco, Calif.

1111 Dragon St.
Dallas 7, Texas

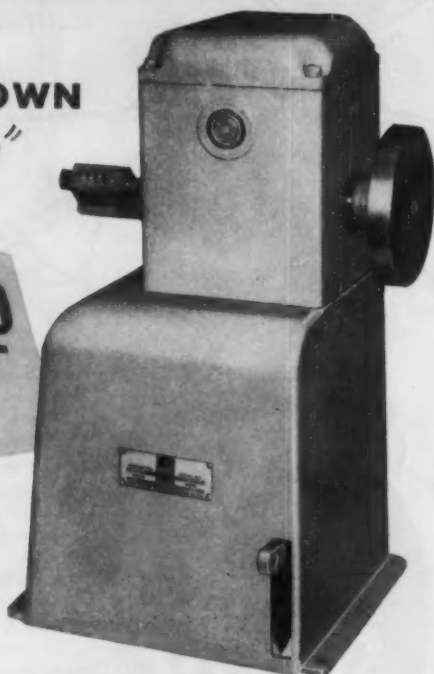
Now...an ALL-PURPOSE COIL WINDER DRIVE

the
ALL-NEW CROWN
"Series 50"

\$198⁰⁰
without motor*

F.O.B. Woodstock, Ill., State
or local sales tax extra, if
any. Prices apply in U.S.A.
only.

CROWN "Series 50" Drive, as
standard. Numerous accessories
also available.



• Lower in price than any coil winder drive we know with comparable performance, the new CROWN "Series 50" handles field, mush, armature coils up to 5 H.P., as well as solenoid, electromagnetic and other small coils. It puts more profit into your shop. It does not require the time needed to set up complicated coil winders. It takes up little floor space—is easily adaptable to all type heads. Ideal for the special one-time coil winding jobs that every motor repair shop must handle.



With the new CROWN "Series 50" you can handle practically every job that comes into your shop. It can be mounted on any bench. It is a portable unit that can be taken out of the shop to the job, or can be used in a mobile repair unit. A powerful "package" in a compact design, it provides a full 13" swing. It is ideally suited to smaller shops, or as a second unit in high volume operation . . . Constant torque clutch and brake controlled in one operation give precise control over every job.

CROWN "Series 50" Bench Coil Winder Drive with Crown "Universal" Winding Head for winding series of 6 diamond coils, illustrated, and many other types and sizes. (Head is sold and priced separately. Clutch pedal shown is optional at extra cost.)

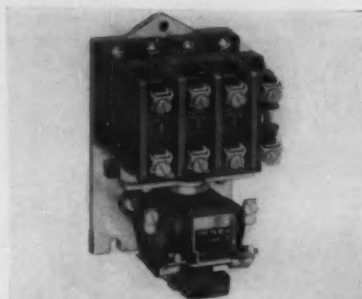
*May also be purchased with motor, \$225.00.

SEE YOUR CROWN DISTRIBUTOR OR WRITE FOR FULL INFORMATION



CROWN

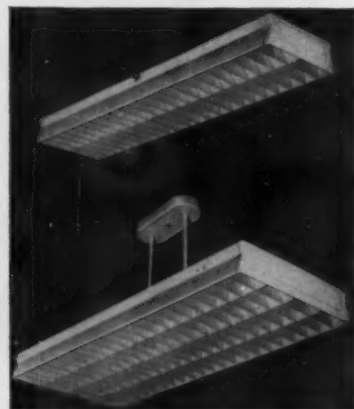
INDUSTRIAL PRODUCTS COMPANY
719 Amsterdam Street, Woodstock, Illinois



Control Relays (28)

A new line of 10-amp control relays has been designed to occupy minimum panel space. The line includes relays with from two to 12 poles. Type PM relays feature a unique sectional pole design. Each pole is mounted in its own individual melamine block. Poles are individually removable and replaceable without disturbing other poles or other wiring. Construction of pole blocks is such that each pair of contacts is contained in its own arcing chamber, with melamine walls between poles. This permits relays to be mounted side-by-side with no clearance required. On top, poles are also enclosed, forming a continuous melamine shelf on which wiring may be run. On bottom, only $\frac{1}{8}$ -in. is required for changing magnet coil. Poles can be converted from normally-open to normally-closed, or the reverse, in the field.

Clark Controller Company, 1146 East 152d St., Cleveland 10, Ohio



Lighting Fixture (29)

A new line of louvered lighting fixtures, known as Louvron, feature "translucent steel" side panels of Perflax. This new material is a sturdy-gauge steel which is perforated with thousands of fine holes coated inside and out with a plastic film which fills and converts each hole into a tiny lens. It is suitable for public buildings and institutions. Available in 4- and 8-ft lengths and 2- and 4-light widths, rapid start or slimline, surface or stem-mounted with 35°-25° or 35°-45° louvers. Steel or polystyrene side panels are available in addition to Perflax.

Lightolier, Jersey City 5, N. J.

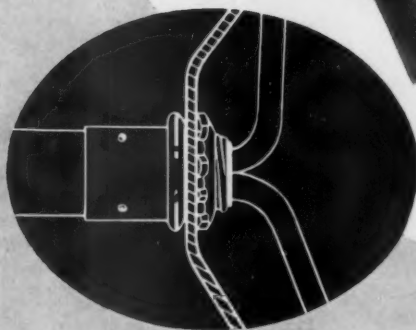
Red Throat

**B-M 21B, THE NEW INSULATED THROAT
INDENTER
CONNECTOR
FOR E.M.T.**

*Four Ways
Finer*



- 1** Protruding rounded red plastic lip of bushing prevents cutting of insulation—eliminates shorts.
- 2** Full thread screws into all conduit fittings. Lip of RED THROAT bushing protects thread from damage.
- 3** Deep dished eight pronged lock nut is easier to drive on—screws flush to shoulder and digs into metal of box for vibration proof positive ground.
- 4** Permanent locked-in bushing insures smooth burr-free raceway for easy fishing. No extra work and costs no more.



Briegel, the Original Indenter Fittings are neater in appearance, easier and faster to use. Installation is simple and less expensive. Two quick squeezes sets them forever. Try B-M Indenter Fittings and get more profits from each job!

ALL BRIEGEL FITTINGS ARE U. L. APPROVED AS CONCRETE-TIGHT

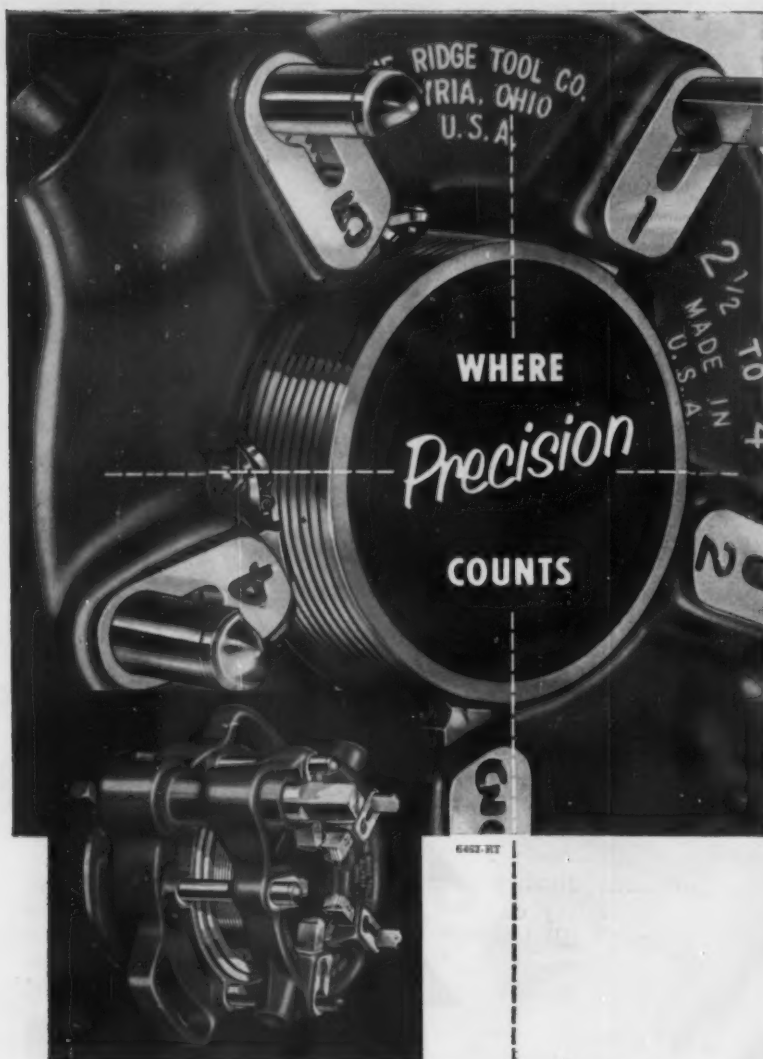
Order from Your Wholesaler!

All B-M Indenter Fittings are U.L. Approved as concrete-tight and for general use (File Card E10863). Also comply With Federal Specifications W-F-406.



BRIEGEL METHOD
TOOL
CO.
GALVA • ILLINOIS

Warehouse Stocks in Principal Cities for Immediate Delivery!



...use the **RIDGID 4P** 2½" TO 4" GEARED PIPE THREADER

Here's a work-saving precision tool that cuts accurate threads on 2½" to 4" pipe *every time*. It's easy to handle . . . easy to use . . . foolproof.

Operated manually or with power, the **RIDGID 4P** reduces time, sweat and scrap in any piping job. Balanced handles simplify carrying and starting on pipe. Mistake-proof workholder sets to size *before* tool is put on pipe . . . has only one screw to tighten . . . no bushings.

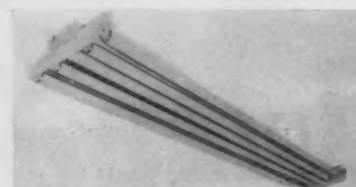
For precision and speed . . . you can't beat the **RIDGID 4P!**

4P CONDUIT THREADER ALSO AVAILABLE.

See your local supplier
... or write direct for
catalog.



MANUFACTURED BY THE RIDGE TOOL CO. • 454 CLARK STREET • ELYRIA, OHIO



Lighting Fixtures (30)

New open type fluorescent lighting fixtures known as the Ranger Series. They are available in 4- and 8-ft lengths for two or four lamps. A special feature is push-type, spring-loaded sockets which are metal clad. Tapered design of sockets minimizes shadow between lamps when units are mounted in fixture runs. The 4-ft units are furnished with rapid-start ballasts; 8-ft units can be supplied with either slimline or high-output rapid-start ballasts. Folder, Form OD-636, is available.

Day-Brite Lighting, Inc., 16 N. 9th St., St. Louis, Mo.



Switches (31)

A new line of No-Klik quiet switches with silver contacts. They operate in any position for both incandescent and fluorescent lamp loads. The mechanism is totally enclosed with large head No. 8 binding screws, and the switch takes any wire size up to No. 10. For ac only, they come in brown or ivory, 15 amps, 120 and 120/277 volts and 20 amps, 120 and 120/277 volts. The 20-amp switches are identified by a red moulded cover. They are approved for control of fluorescent lamps on ac circuits of 277 volts and less and for motor loads up to 277 volts at 80% of current rating of switch.

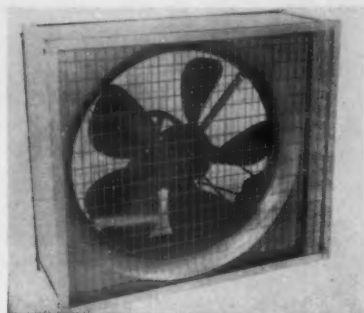
Circle F Mfg. Co., Trenton, N. J.

Baseboard Heater (32)

A new electric baseboard heater is available. Units are installed along the wall in place of baseboards, and provide heat both by radiation and convection. Heaters can be operated with furniture placed flush to them or with draperies hung above and against them. Temperature of vertical outer surface is approximately 100° F. Installed in 2-ft sections,

as many units are used in each room as engineering specifications require. A control panel is coupled into heating system of each room, allowing room-by-room use. Operates on 240 volts ac. Although designed primarily for surface mounting, units can be recessed to mount against studding. Units are rated at 250 watts per foot. They are 7 in. high and 2½ in. wide.

Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.



Fan (33)

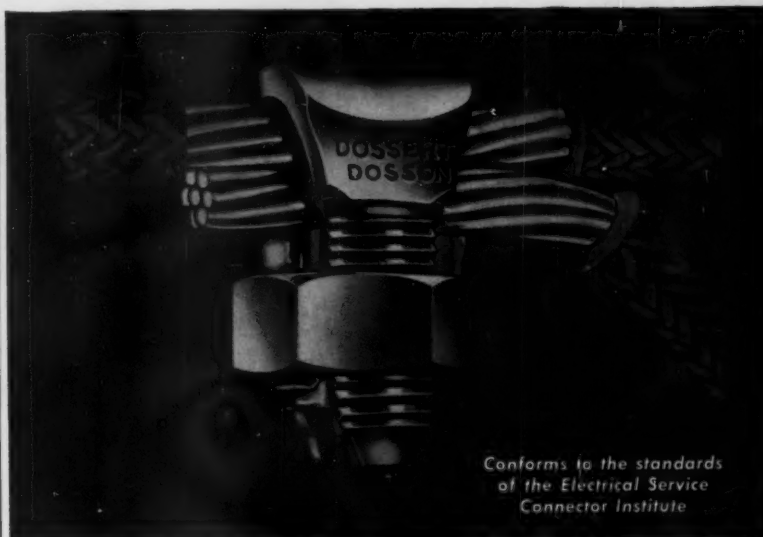
A new "Man Cooler" fan which mounts anywhere and delivers 5,600 cubic feet of air per minute with its 24-in. Topping-ton fan blades is for use in industrial plants. When hung from ceiling girders or rafters, penetrating air flow provides air circulation for a considerable distance along any industrial production line. All moving parts are rubber isolated from the flexible frame and steel case. Safety guards are provided both front and rear. A deep drawn steel orifice contributes deep air penetration and maximum air flow. Other features include a rubber-mounted ball bearing fan shaft, automatic belt tension for elimination of slippage and motor bearing wear, and choice of either sleeve or ball bearing, ½ hp motors. While 115-volt, 60-cycle motors are supplied as standard, other voltages and types may be ordered.

McLean Engineering, P. O. Box 228, Princeton, N. J

Annunciator (34)

SC-10 annunciators were developed for a broad range of application. They consist of the standard DE line cabinet, special plug-in relays and a special lite box with a 2-section backlighted nameplate. Each field signal is connected to a separate alarm circuit and even though a common plug-in and lite box is used, the complete operation of the alarm sequence is independent of either of the field signals that are connected to a common plug-in and lite box combination. Since standard DE line cabinets are used, all existing standard systems may be enlarged by installing this new plug-in and lite box in the standard cabinet. Thus a 30-unit cabinet could be converted to provide for as many as 60 separate alarm indications.

Scan Instrument Corporation, 3909 W. Irving Park, Chicago 18, Ill.



Conforms to the standards
of the Electrical Service
Connector Institute

DOSSERT "F" SPLIT BOLT CONNECTOR

Fabricated from high strength alloys (better than average steels), the Dosson "F" is cold-formed for uniform quality. Maximum contact pressure is assured by a high translation of tightening torque. Full length pressure bars with rounded edges prevent load concentration and crushing of conductor. Built to withstand high overload, vibration. Highly corrosion resistant.

**Mail coupon for FREE
Dosson "F" Connector**



DOSSERT MFG. CORP.
249 Huron St., Brooklyn 22, N. Y.

Gentlemen:

Please rush free sample Dosson "F" Split Bolt Connector plus catalog sheet.

Name Title

Company

Address Zone State

City



DOSSERT MFG. CORP.
249 Huron St., Brooklyn 22, N. Y.

Plugmold

is 6 ways better

than any other type multi-outlet system



Here Plugmold provides outlets under a window wall.

PROVED on thousands of installations!

- 1. Easiest to Install.** Plugmold raceways can be attached to *any* surface. $\frac{1}{2}$ " knockouts located on approximately 8" centers permit the strip to feed anywhere along its length.
- 2. Fastest to Install.** Snapicoil ready-wired receptacles *snap* into Plugmold raceway cover, provide a fast, *quality* installation in a continuous run.
- 3. Many More Outlets at Minimum Cost.** Duplex outlets are conveniently located every 60", 30" or closer, in a continuous run. Proved *in use* to be the most practical multi-outlet surface raceway system ever devised for homes, offices, stores and industry.
- 4. Inconspicuous.** No bulky feed boxes, no protruding receptacles. Unobtrusive Plugmold raceway can be painted to blend with color scheme of any room. Plugmold is "out of sight, never out of reach."
- 5. Permanent.** Snapicoil receptacles are flush with the *life-time* Plugmold steel surface raceway. Nothing to protrude or break.
- 6. Provides Better Electrical Service.** 3-wire duplex receptacles, with one side switched and one hot; 2-wire duplex receptacles, with both sides hot; NEMA 2-wire, grounded receptacles — all 3 services fit the one Plugmold raceway.

The services of our engineering staff are available to help with any wiring problem you have. Write to Dept. E9

Stocked by electrical wholesalers... everywhere.



THE WIREMOLD COMPANY

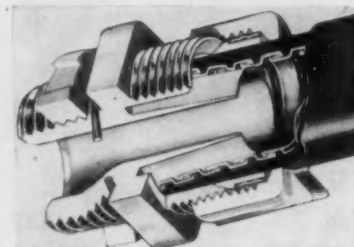
HARTFORD 10, CONNECTICUT

Staple Gun

(35)

A new staple gun, the T-25, for fastening low voltage wire automatically, safely and without danger of short circuits or wire damage. Safety factor is one-hand operation. Staple fits tightly because it is designed with a round crown. The exclusively-designed bottom edge tapers down to a size just slightly wider than the wire itself, and fastens wire in tight corners. The staple used by the gun is the Arrow T-25 round top staple. They are available in two sizes: $\frac{1}{8}$ -in. leg size and $\frac{3}{8}$ -in. leg size; the same machine uses both sizes.

Arrow Fastener Co., Inc., 1 Junius St., Brooklyn 12, N. Y.



Fittings

(36)

Liquid-tight conduit fittings are now available in sizes to accommodate conduit diameters of 2 $\frac{1}{2}$, 3- and 4-in. These larger sizes are used particularly in food processing, chemical and other fields where wiring is exposed to corrosive liquids. Because of integral, threadless grounding cone, fittings accommodate any flexible conduit spiral and may be installed without disassembling. Made in straight, 90-degree and 45-degree elbow designs, the new line is designed for installation on EF types of liquid-tight raceways.

Thomas & Betts Co., Inc., Elizabeth 1, N. J.



Bin Lights

(37)

Abolite bin lights are now furnished to provide proper lighting of bins and shelves along aisles of stock rooms, tool cribs, warehouses and similar locations. Light is directed to each side of aisle and bin or shelf interiors are illuminated from top to bottom. Shielding at each end of unit prevents direct glare along length of aisle. Furnished in all-white titanium porcelain enamel, both outside and inside, bin lights are available for either pendant or outlet box mounting, and in 100-, 150- and 200-watt lamp sizes.

Abolite Lighting Div., Jones Metal Products Co., West Lafayette, Ohio.



...USE PARANITE
(Non-Metallic sheathed)

PARAFLEX
(cable)

LAYS FLAT
... WON'T SQUIRM OR TWIST

Paranite Paraflex non-metallic sheathed cable is clean to handle ... clean on the job. Saves you installation time because it is non-sticking and smooth and easy to pull. Has Type T thermoplastic insulated conductors.



● Every step in the fabrication of Paranite Paraflex is subject to rigid quality control.



● Rip cord makes it easier to strip ... and Paranite Paraflex is smooth and easy to pull, too.

PARANITE WIRE AND CABLE

DIVISION ESSEX WIRE CORPORATION

Fort Wayne 6, Indiana

MANUFACTURING PLANTS: Birmingham, Ala.; Anaheim, Calif.; Jonesboro, Ind.; Marion, Ind.



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It's just good sense:

Wagner Replacement Parts for Wagner Motors—

Genuine Joe says:

**"when it comes to
replacements, the best
bearings for Wagner
Motors are Wagner Bearings"**



**Highest
quality**



**Perfect
fit**

"You wouldn't put kerosene in your car's gas tank, so why put anything but the real McCoy—Wagner sleeve bearings—in your Wagner Motor?"

Easy to replace with the Wagner Bearing Tool!



"You'll find it's easy to replace the old bearing with a new Wagner bearing when you use the special Wagner bearing tool. A single, easy operation removes the old bearing and aligns the new bearing perfectly. There's no pounding, no reaming...and with the Wagner bearing tool, you can't botch the job or ruin the bearing."

"While we're at it, my boss says Wagner bearings are precision-bored, steel-backed and babbitt-lined to give them extra load-carrying capacity. What that means is Wagner bearings are carefully made so that they last longer than ordinary bearings. They won't seize or grab and they don't corrode. A complete line of sleeve bearings for all Wagner Motors is carried in stock by Wagner branches."



WAGNER ELECTRIC CORPORATION
6413 Plymouth Ave., St. Louis 14, Mo., U. S. A.

MOTORS · BEARINGS · STANDARD MOTORS
BRUSHES · CAPACITORS · COMMUTATORS

**OVER 850 AUTHORIZED SERVICE STATIONS
OR PARTS DISTRIBUTORS**

M555-9



Transformers

(38)

A new line of smaller and lighter Class B control transformers in standardized sizes. New materials, including Alkanex wire have been used, and a unique method of frame size design. Within each frame size, which is related to volt ampere capacity, a wide variety of voltage combinations is available, with no change in overall and mounting dimensions. Units are available in dual frequency (50/60 cycle) and series-multiple ratings. The initial 11 transformer frame sizes announced as available include the most popular ratings, 25 va through 2.0 kva for conduit wiring and 25 va through 250 va for open wiring. They are approved for listing by Underwriters Laboratories.

General Electric Co., Schenectady 5, N. Y.



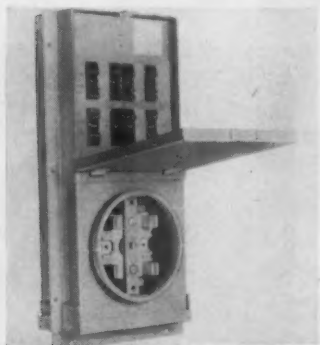
Air Conditioner

(39)

The new "Roomette" air conditioner sits on the floor instead of a window-sill. It measures 27 in. high, 15 in. wide and 28 in. deep and has a flat marproof top so that it can double as an end table or lamp table. All controls and grilles for movement of conditioned air are located on front panel. Developed originally for use in mobile homes, the unit can be applied to almost any room in an ordinary residence. Air for refrigerant condensing is drawn through bottom instead of back of unit. For first floor locations in a house built over a crawl space or with a well-ventilated basement, a 13- by 15-in. hole is cut in the floor to fit opening at bottom of unit. Unit is then set over hole and provided with electric power. In second floor

and other installations where direct condensing into unused space below is not possible, a short duct can be run from bottom of unit through exterior wall. Unit is made in a $\frac{3}{4}$ hp model designed for use with standard 115-volt circuits. Unit cools and dehumidifies, cleans and circulates the air.

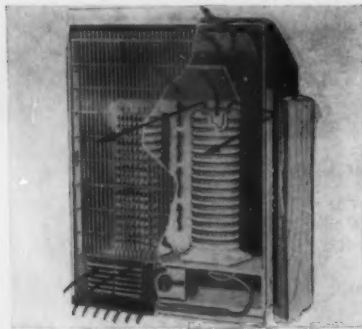
Carrier Corporation, Syracuse, N. Y.



Meter Socket-Load Center (40)

A new residential service entrance device that combines a meter socket and circuit breaker load center in a single unit. Two versions of the combination unit are available. One has a 50-amp 2-pole common-trip main breaker wired in, and provides six branch circuits. It can utilize one other 2-pole breaker besides the wired-in main breaker. It is rated for 120/240 volts ac, single-phase, 3-wire service. The other version is similar except that it is an 8-circuit device with mains rated 70 amps, and meter is wired directly to load center bus bars rather than through a main breaker. It provides a maximum of two double-pole branches. Both are available in either semi-flush or surface raintight enclosures and are U/L listed.

Trumbull Components Department,
General Electric Co., Plainville, Conn.



Electric Heaters (41)

A new line of radiant-convection electric wall insert heaters, called "Guide-Ray". Cone design permits heat to be reflected out into the room. The "wide-open" perforated grille design is repeated at the normal location of base of frame, enabling thermostat bulb to be located directly in incoming room-temperature air-stream. Bulb is free from effects of



MODEL 1986

You'll like THIS GREAT PORCELAIN PRODUCTS' WIREHOLDER

AND THESE SECONDARY SERVICE MATERIALS



You'll like Porcelain Products' metal reinforced No. 1986 wireholder. They're built to standards of ruggedness and reliability that assure top performance for generations. Metal in tension, porcelain in compression—hot dip galvanized steel parts—extra sharp, lubricated threads—large pulley-action wire hole makes this the finest wireholder on the market.

A complete line of secondary service materials built to the same high standards of quality and dependability are also available for every service installation.

You can depend on the name Porcelain Products—the byword for "Quality" for more than 60 years.



Now packaged in a handy carrying carton with real handles.

61
years

ELECTRICAL PORCELAIN SINCE 1894

Porcelain Products, Inc.

FINDLAY, OHIO

PP
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ONE HAND CONVENIENCE

for fastening to steel or concrete

Ramset
FASTENING SYSTEM

SPEEDS WORK ON
LADDERS & SCAFFOLDS



other Ramset exclusives:

- FAST CHANGEOVER
for light, medium, heavy duty
- JOB-MATCHED SYSTEM—
exactly the fastener you need
- PIN-POINT CONTROL
for accuracy and speed
- NEARBY SERVICE whenever
or wherever you need it
- FASTENING LEADERSHIP
keeps Ramset FIRST in the field

For
complete
information,
write

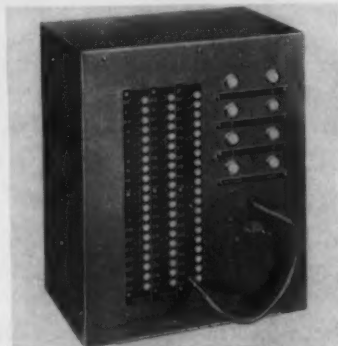
Ramset Fasteners, INC.
RAMSET DIVISION—OLIN MATHIESON CHEMICAL CORPORATION

12105 BERA ROAD • • • CLEVELAND 11, OHIO



conducted and radiated heat from cones. Spacing and design of lip-slot louvers decoratively cover thermostat housing and all interior wiring. Raging from 1000- to 4000-watt capacity, heaters are being produced in eight models of 1-, 2- and 3-unit styles. All are available in gray hammer-tone finish. Single-cone models are offered also in chrome for bathroom use.

Everwarm, Inc., 2925 N. Central Ave., Knoxville, Tenn.



Return Call Annunciator (42)

A new return call annunciator unit with a 180-station capacity that measures 12 in. wide by 15 in. high. Operation is simple. For example, to call room No. 512, the operator plugs the phone jack into station 12 on the vertical panel and presses the 5th floor button. The occupant of room No. 512 answers by pressing a button at his station which extinguishes the light next to station 12 on the master panel. Unit can be either surface or flush mounted. The relay cabinet may be remotely located.

Auth Electric Company, Inc., 34-20 45th St., Long Island City, N. Y.



Entrance Cap (43)

"Swing Top", a new entrance cap with hinged swinging hood and clamp method of attachment to standard rigid conduit and EMT. The patented one-piece hinged construction permits hood to swing open and hang safely out of the way after the single screw has been loosened. Wires are then quickly and conveniently pulled through the head. A longer radius or arc is also featured to facilitate handling of

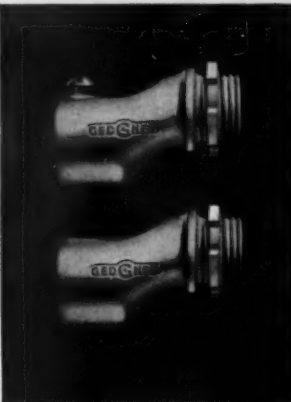
FOR ROCK-BOTTOM INSTALLATION COSTS *SPECIFY GEDNEY!*

GEDNEY FITTINGS are machined and threaded with utmost accuracy...smooth-finished, with no metal particles or burrs...made of malleable iron to eliminate breakage...individually inspected to

ensure absolutely top quality. That's why they're quickest, least costly to install...Specify Gedney Fittings and you'll find, like thousands of others, that this is the most profitable line available today!



Gedney 90° Pull-In Elbs and Adapters with Neoprene gasketed cover and self-retaining screws. These fittings may be used to convert a straight box connector into a 90° connector, or as a 90° box connector for rigid standard pipe coupling. Elbs have female threads at both ends. Adapters have male threads at one end and female at the other. Made of malleable iron and cadmium plated. Sizes $\frac{1}{2}$ " to 2".



Gedney Offset Connectors—eliminate the necessity for offsetting conduit at knockout entrances of standard boxes. Threaded for rigid, set screw for EMT. Made of malleable iron, cadmium plated, in sizes from $\frac{1}{2}$ " to 2".



Gedney Corner Pull-In Elbows are outstanding for space saving, machine wiring, easy wire pulling. Malleable iron, cadmium plated. Made in $\frac{1}{2}$ ", $\frac{3}{4}$ ", 1", 1 $\frac{1}{4}$ ", 1 $\frac{1}{2}$ " and 2" sizes.



Gedney Offset Coupling—female both ends—for use as an offset between boxes. Can also be used with conduit nipple (Gedney 7-50 series) to give more room in box than otherwise possible.
Gedney Offset Nipple, male both ends.

Both of these fittings are made of malleable iron, cadmium plated. Available in sizes from $\frac{1}{2}$ " to 2".



GEDNEY FITTINGS FIT

GEDNEY
ELECTRIC COMPANY



RKO BLDG. • RADIO CITY • NEW YORK 20
Foundry, Factory and Shipping Point: Terryville, Conn.

design
by
mc Philben



A Vapor-Tight Wall Bracket

dynamically new . . . obsoletes
all old wall brackets!

A modern building with yesterday's fixtures is like a lovely woman wearing last year's hat. McPhilben's new multi-use wall bracket the '43-40 series is beautifully honest in design . . . of rugged, no maintenance-needed, die cast aluminum vaportight, versatile and competitively priced.

APPLICATIONS: Stair landings, Corridors, Lavatories and Entrances, Schools, Hospitals, Office buildings and Housing.

SPECIFICATIONS: 43-40 VT, die cast aluminum, satin finish anodized, quickly mounts to 4" cast iron junction box . . . for indoor application suitable for standard outlet box.

WATTAGE: Maximum 100 watt — Globe: Threaded opal with gasket. Write for Data Sheet on complete VAPORTIGHT SERIES.

DIE CAST PROTECTIVE GUARD AVAILABLE (43-44VT) for locations where protection against theft and vandalism is essential. Also available as a ceiling fixture.



1333 Willsoughby Avenue, Brooklyn 37, N. Y.



Representatives in major cities
Stocked By Electrical Wholesalers

wires and avoid sharp bends. Five sizes are available for standard rigid conduit and EMT from 1/2-in. to 2-in.

Electrical Fittings Corp., 37-50 57th St., Woodside 77, N. Y.

Electric Heaters

(44)

A new line of electric heaters, with standard and deluxe models in both wall panels and portable models, as well as standard baseboard units. Baseboard units are supplied in two capacities—1050 and 1550 watts. Wall panels in four models, ranging from 800- to 1050-watt capacity. Portables have 1000-watt capacity. All are manufactured for 115 voltages; and many models also may be secured for 240 voltage.

Infraglass Heater Co., Inc., 350 S. Sanford St., Pontiac, Mich.

Product Briefs

(45) A new pocket sized contact burnisher No. 160 has been introduced by the Adre Company, Hales Corners, Wis. . . . (46) Rome Cable Corp., Rome, N. Y., has announced the adoption of non-returnable reels as standard put-up for certain of its wire and cable products . . . (47) The Elox Corporation of Michigan, Clawson, Mich., has introduced a new automatic line voltage regulator designed to meet the increased demands for the control of electrical energy for precision machinery.

(48) An electrical interlock in a circuit which allows pushbutton control can now be obtained by use of an instant action auxiliary switch in a new model Agastat time delay relay developed by the A/G'A Division, Elastic Stop Nut Corp. of America, Elizabeth, N. J. . . . (49) A new line of completely sealed, environment-proof limit switches has been developed by Micro Switch of Freeport, Ill. . . . (50) Photoswitch Division, Electronics Corporation of America, Cambridge, Mass., has announced a Densitometer, Set P4S, a ready-to-use photoelectric control with many applications in textile, paper, chemical, petroleum and plastic industries.

(51) A new electrical cord for portable machinery, called the U.S. Laytex Royal Master portable cord, has been developed by United States Rubber Co., New York, N. Y. . . . (52) A new metal attachment for a conventional 6-ft folding rule serves as a working guide for forming bends in conduit, bus bars and pipe. Called a "Protractor-Rule Attachment" it is manufactured by C & B Engineering and Fabricating Corporation, Houston, Texas. . . . (53) Square D Company, Milwaukee, Wis., has announced a newly designed, low-cost water pump switch, identified as a class 9013, Type JSG, for shallow well water systems involving pressures up to 60 p.s.i.

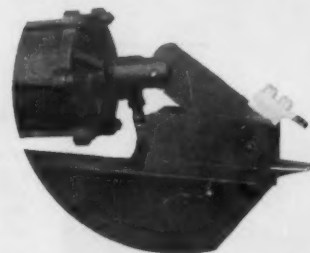
COIL CUTTING TIME REDUCED TO 30 SECONDS!

**P&R's STATOR COIL CUTTER
Makes Traditional Methods
Obsolete—Read Why:**

**Another Big Step Toward More
Profitable and Efficient
Operation!**



- Makes Tedious Unpleasant Job EASY
- No Set-Up—No Adjustment—No Skilled Operator Needed
- Eliminate Damage to Laminations and Stators
- Phenomenal Speed and Ease of Operation



As a power bandsaw is to a handsaw, P&R's new Stator Coil Cutter is to conventional methods of cutting coils from stators. The average fractional stator is cut in as little as thirty seconds . . . and small integral horsepower stators require only slightly longer.

Simply hold the stator up to the machine with the coils on the anvil. Operate the air cylinder foot pedal, turn the stator as the coils are cut off. Job's done in a flash. Also, you stop the expense of damaged laminations and stators. P&R quality throughout . . . heavy duty construction . . . powerful 6" air cylinder . . . cutting blade and anvil made of finest available tool steel, heat treated for long service and durability. We'll ship on approval—order yours TODAY!

Call, Wire or Write
For Complete Details

POTTER & RAYFIELD, INC.
Engineering
Craftsmanship
P. O. Box 1042 Atlanta, Ga.

CATALOGS and BULLETINS

(54) TRANSMISSION TOWERS. Body and leg extensions to meet uneven ground conditions and desired height are described in 4-page bulletin 2509. Blaw-Knox Co.

(55) MICRO SWITCHES for industrial applications are detailed in 28-page catalog 83 which has been specially assembled to meet information needs of plant engineers and maintenance men. Micro Switch.

(56) COLD CATHODE LIGHTING is the subject of a comprehensive new catalog 3 which explains basic principles of this method of illumination, gives electrical and life ratings of various lamps, and features complete technical descriptions of available fixture assemblies, including explosion-proof units and square and round recessed assemblies with plastic diffusers. Cold Cathode Lighting Corp.

(57) BUSWAYS. Two bulletins: GEA-6169, 8 pages, discusses construction features and operating characteristics of aluminum busways, points out advantages derived from use of aluminum; 4-page GEC-1326 covers current-limiting busway, includes specifications, design characteristics, and table giving electrical parameters and voltage drop of type CL busways. Distribution Assemblies Dept., General Electric Co.

(58) MAINTENANCE TOOLS, safety equipment for production plants and motor shops are itemized in 64-page catalog 30. Particular emphasis is placed on meters and machines for preventative maintenance checks and repair of motors. Martindale Electric Co.

(59) WIRING REELS and measuring devices are illustrated and described in an 8-page bulletin including application information and prices. Hykon Manufacturing Co.

(60) CABLE TROUGH in 6-, 9-, 12-, 18- and 24-in. widths is itemized in 12-page bulletin 67A which shows all available fittings along with dimensions and installation data. T. J. Cope, Inc.

(61) POWER HACK SAW can be used with special power unit or with regular 1/4-in. heavy-duty drills. Applications and the four different models are shown in 4-page folder. Key-Hak Div., Producers and Distributors, Inc.

(62) WIRE AND CABLE. Revised sections of main catalog cover bare and coated wire and cable and weatherproof wire and cables; sections 14-

BEST BY TEST!



Every LEV-O-LOCK device is carefully checked and inspected before leaving the factory. Individual items are selected at random from the production line and submitted to exhaustive tests in the new Leviton Testing Laboratories. The "pull-out" test, illustrated, is just one of the many tests to which these devices are subjected.

LEV-O-LOCK, the modern design electrical connector that locks securely with a turn of the cap, to provide a secure connection that will not shake or pull loose . . . assures uninterrupted flow of power. LEV-O-LOCK devices are a must in factories for all electrical equipment; in offices for electric office machines; on farms for electric milking machines; in the operation of portable power tools and other electrical apparatus.

These new devices incorporate every up-to-the-minute advance in design and engineering. New features include heavy gauge phosphor bronze, double wiping contacts for all receptacles. Extra large terminal screws and ample room make wiring fast and easy. Rigid quality control from raw material to final inspection is your assurance of a superior product.

Try LEV-O-LOCK yourself and you'll agree that LEV-O-LOCK devices are tops for quality and performance at sensible prices. Why pay more when the best costs less!

LEV-O-LOCK devices available in 2, 3 and 4 wire caps, connectors and receptacles in 10 and 20 Amp. ratings. Also 3 and 4 wire rubber caps. Listed by Underwriters' Laboratories and C.S.A.

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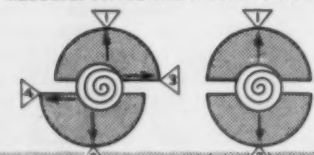
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70, -75 and -80. Booklet DM-5566, 10-pages, illustrates the step-by-step procedure for splicing neoprene-jacketed Durasheath cables. The use of Powerduct cables for flexible drops from overhead bus duct is described in 4-page folder DM-5541 which includes technical data on both Dura-cord and plastic cable. Anaconda Wire and Cable Co.

(63) FANS. Two new models, a bypass duct fan and a double-ring reversible fan are featured in 40-page catalog A-109A. Complete data is included on 18 other types plus intake units, unit heaters and accessories. Hartzell Propeller Fan Co.

(64) RECTIFIERS. Germanium power units are available in two styles—convection or fan cooled. Germanium rectifiers are ideal for applications now handled by mercury arc rectifiers. Bulletin GPR-1. International Rectifier Corp.

(65) LIGHTNING ARRESTERS, fuse cutouts, and accessories are the subject of 20-page bulletin LA755. Special design features and operation of the Autogap series of arresters is covered along with complete listing of ratings, dimensions and mounting instructions. Hubbard & Co.

(66) OUTDOOR LUMINAIRE for sign lighting employs slimline lamps in an aluminum housing with weather-proof neoprene sleeves, is designated the SOD/M4 series; 8-page booklet. Columbia Electric & Mfg. Co.

(67) POWER CAPACITORS rated at 25-kilovar are described in bulletin GEA-6260 which illustrates and details construction features and manufacturing controls that assure continuous service. General Electric Co. (68) INFRARED HEATING uses in manufacturing processes are discussed in a 20-page booklet entitled "Applications Unlimited". Fostoria Pressed Steel Corp.

(69) RESIDENTIAL LIGHTING. Illustrated 8-page brochure covers newly designed units for various living areas. Globe Lighting Products, Inc.

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(71) TRANSFORMER CONNECTIONS are diagrammed and explained in a concise 8-page bulletin CS-102 covering 17 different hookups. Kuhlman Electric Co.

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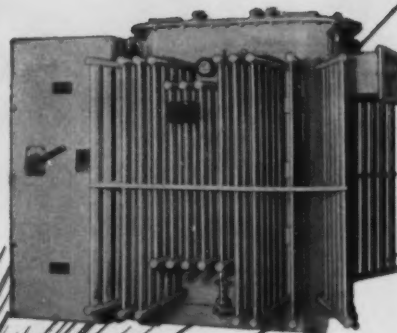
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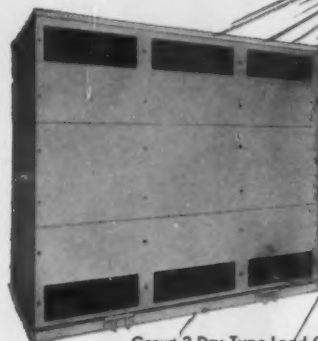
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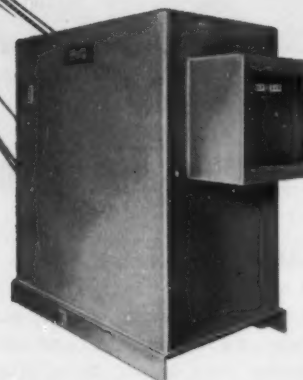
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Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay \$5.00.

Third Harmonic Current in Transformers

QUESTION N28—I recently heard an engineer talking about "third harmonic circulating current" in a 3-phase transformer bank. What is this circulating current, and why can't it be blocked? Does it reduce the capacity of the transformer?—D.H.N.

ANSWER TO N28—The exciting current of any iron core transformer must contain triple harmonics if the voltage is to be a sine wave. In a 3-phase delta these triple harmonics are in phase (all other harmonics are 120° out of phase) and form a circulating current "around the delta". Because the voltage necessary to cause this current to flow and the current itself are small, it does not affect the transformer rating. This is a very desirable condition because the necessary triple frequency excitation current is available wholly contained within the transformer and does not appear across the lines.

To eliminate this circulating current, a sinusoidal exciting current would be necessary which would give non-sine voltage and flux both of which are undesirable.

A 3-phase Y-Y connection has the triple harmonics appear as a line to neutral voltage which can cause serious over voltages due to resonant conditions on the line.—C.W.M.

ANSWER TO N28—In a 3-phase transformer bank connected delta, the third harmonic-generated voltages will cause a current to circulate in the closed delta. The third harmonic is the third multiple of the input wave form, usually a sine wave of certain frequency, and is simply a distortion of this original wave. The distortion in the input sine wave is caused by variations in the reluctance of the flux path and variations of the load on the transformer bank. This current generated at triple frequency will circulate in the closed delta loop and hence is called the third harmonic circulating current. There is no third harmonic circulating current in a wye connected bank.

There are methods to block or filter this third harmonic current. Oft times this third harmonic current is very disturbing and objectionable in telephone lines and long transmission lines in certain instances.

This third harmonic current is a rather desirable feature in a transformer bank for it acts as a component of the magnetizing current for the core. However, adequate protection relaying is recommended to compensate for this magnetizing inrush current. This, however, can be worked out very easily by using a relay designed for this purpose. Oftentimes in a wye-wye connected bank, a tertiary winding, connected delta, is used to supply this triple frequency component.

Therefore, the capacity of the bank is not greatly affected unless the circulating current becomes too high and the transformer bank is stressed due to unbalanced conditions.—J.B.K.

ANSWER TO N28—The permeability of iron changes as the magnetic density varies. To generate a sine wave of voltage the exciting current is not sinusoidal, but it is distorted. A distorted wave form can be resolved into components consisting of a fundamental wave at the fundamental frequency and the waves of other frequencies which are multiples of the fundamental frequencies and called harmonics. Exciting current of a transformer can contain only the odd numbered harmonics 3rd, 5th, 7th, etc. The third harmonic is the principal one involved. The relative magnitude depends on maximum flux density. For the average single transformer, current corresponding to the third harmonic is 20% to 30% of the total exciting current.

In single-phase circuits, the third harmonic offers no difficulty, but when Y connection single-phase are connected in 3-phase some important factors arise.

The third harmonic voltages may run as high as 50% to 60% of the fundamental voltage if the neutral wire is not grounded. Also if harmonics are present the potential of the neutral will be found to vary above and below that of ground at three times fundamental frequency. These harmonic voltages are objectionable because of voltage stress between windings and ground.

Grounding the neutral point of a 3-phase system will eliminate above objections, but brings up others.

To eliminate the harmonic in large 3-phase double-Y-connected transformers a third winding, delta-connected, called a tertiary, is used to eliminate the harmonic.—P.J.L.

Application of Electric Heating

QUESTION P28—In a public building 100 ft long by 40 ft wide, height 16 ft, what type of electric heating would be the most efficient?—E.S.H.

ANSWER TO P28—An automatically controlled humidity and temperature system utilizing enclosed elements with a fan system through distribution ducts, is most efficient. Ducts can be easily routed through corridors and brought into offices. If the ceilings are limited, they can be lowered with new metal pan installations and recessed lighting installed.

Outside makeup from doors being opened will compensate for necessary air changes. The advantage of installing the duct system initially is that it can be easily converted for air conditioning by adding the refrigeration equipment at any time.—L.W.F.

ANSWER TO P28—A building of the dimensions mentioned would necessitate enormous electric heating capacity. Without knowing the type of building construction, and insulating qualities and for what public use the building was intended, concealed strip heaters would be the most efficient type to install.

However, if the duct work is already installed, a central heating unit could be used which would be more agreeable and safer as far as the public is concerned, but also somewhat more expensive.

Then again, if the building is constructed and well toward completion, wall or ceiling mounted air heaters containing a fan motor and heating elements can be installed on each wall or spaced around the ceiling to provide uniform temperature. These could be automatically controlled with a thermostat, selector switch and contactor as well as manual operation.

For more complete information on this problem, I refer you to: Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.—J.B.K.

Arc Faults on Busway

QUESTION Q28—We have a large plant, which has close to 1,000 ma-



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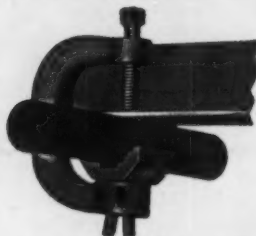


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chines of various sizes for the purpose of forging and machining 8-in. shells for the army. The power required for the motors on the machines is being supplied by load center transformers, 750 kva, through a 1000-amp, 440-volt bus duct. There are 23 such units placed throughout the plant.

In the process of installing or removing a duct switch, the maintenance man creates a ground or short circuit causing a big splash and burns up the switch. Instead of tripping the breaker set for approximately 800 amps, which is only about 25 ft away it travels down the bus duct 150 ft to the dead end and burns up most of the end section along with whatever switches are plugged near that end.

Will somebody explain what takes place, why does it happen, and is there a solution to overcome such a condition in the future?—S.B.

ANSWER TO Q 28—While the circuit breaker may be in good working order, it appears to have enough time delay to permit striking and establishing the arc. The arc itself has impedance which, together with that of the bus duct, holds the fault current below the setting of the breaker.

In situations of this kind, an arc tends to travel away from the source of power. Reference to Fig. 1 will show that the magnetic lines of force about the conductors, and to the left of the fault, all take the same direction inside the U. This concentration tends to force the conductors apart and the fault to the right. If there is any load on the right of the fault, the lines of force due to the arc tend to neutralize those about the conductors at the



Fig. 1

open end—thereby increasing the tendency of the arc to travel to the right.

An arc from one bus to the casing would behave in the same way, except that the casing could be regarded as an infinite number of conductors with those nearest the fault contributing the greatest effect.

Bus duct switches are sometimes hard to handle, clearances are small, and a man on a ladder is none too steady—especially if he is expecting trouble. The only sure way of avoiding future difficulties is to make the changes during a shut-down period.—L.E.B.

ANSWER TO Q-28—The problem of connecting bus ducts to high avail-

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able short circuit sources is plaguing many plant engineers. An understanding of the type of fault and what happens while it is existing may help in future applications of bus duct.

Regardless of how the fault is initially made, it ultimately goes phase to phase. The magnitude of this arc current at the instant the arc flashes over is about 30,000 amps. This is true regardless of the magnitude of the available short circuit current. The arc then travels down the bus away from the transformer. Unless the design of the bus is such that there are mechanical means of breaking up this arc as it moves down the bus, it will continue to the very end. If the bus is quite long or has a high impedance the arc may dissipate itself at some point between the transformer and the end of the bus run. This occurs due to the increase in the impedance between the point of the fault and the transformer which results in a decreasing arc current. At some point this current will become small and the bus voltage will drop off so that the arc cannot be maintained. This entire cycle of operation is quite fast. In the order of a few cycles. The average arc current during this cycle may be lower than the full-load current of the bus. Therefore any device which is to protect this bus from this type of fault will have to operate quite rapidly and at a fairly low current.

If the protective device does not clear this fault, the following action takes place. The bus voltage comes back to normal and the ionized air and vaporized copper trapped in the bus may arc over again. Since the protective device has not the proper characteristic or setting to clear this type of fault the entire action continues until some piece of equipment develops a solid short and can maintain a high fault current for the protective device to function. The resulting damage from this type of fault being allowed to exist can be very high. Usually the bus is burned badly at the point where the arc is halted in its travel. Also switches and other equipment are usually burned badly in this vicinity.

The protection of this bus with a circuit breaker can be done only with some compromising in the setting of the breaker. Sometimes it cannot be done with a breaker at all. The short circuit current should be calculated at the end of the bus run neglecting any motor feedback contribution. The instantaneous trip should be set according to the following rule. On the 240-volt systems the trip should be set to $\frac{1}{2}$ the minimum calculated fault current at the furthest point from the

protecting breaker. On 440-volt systems at .7 times the minimum calculated current. Many times this will give an instantaneous trip setting which cannot be tolerated.

The use of current limiting Ampttrap fuses has been used quite frequently of late. These special type fuses have a characteristic which allows them to blow in less than one cycle at 30,000 amps. They are available in current ranges from 600 amps to 6000 amps. However, when utilizing these fuses, be sure they are true current limiters and not just high interrupting capacity fuses.—E.M.

**Can you ANSWER
these QUESTIONS?**

QUESTION Z28—We have a large sound equipment installation, using about 320 watts of audio power. We are considering powering the filaments of these tubes with dc current to reduce hum, instead of ac. However, someone has said that this will shorten tube life. If so, what is the reason?—L.W.F.

QUESTION A29—When motors are cleaned and repaired, I use a puller to take off the bearings, but when replacing the bearing, I use an induced heat to expand inner race enough to slip the bearing over the shaft. Does induced heat affect the bearing later, or would it be better to press the bearings on cold?—E.S.H.

QUESTION B29—Please explain the operation and type of a motor having nameplate data of 115-volt, single phase, 13 amps and 6 brush holders. The motor has forward and reverse directions.—J.B.K.

QUESTION C29—We have a number of overhead distribution lines around our shop for which we were told to specify Class 3 poles. What, actually, is a Class 3 pole, and what determines the proper grade of pole to use?—D.H.N.

QUESTION D29—We have an ac system in our manufacturing plant, served by the local utility. Would it be possible to use a rotary converter to interchange power from a dc system to our plant?—L.W.F.

**PLEASE SEND IN
YOUR ANSWERS BY OCTOBER 15**

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Another
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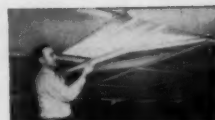
This beautiful room in the new E. I. duPont de Nemours and Company building near Wilmington, Delaware, is a showcase for duPont plastic products. And can you imagine a showcase more effectively lighted than this one with its massing of Wakefield Beta units?

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ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . SEPTEMBER, 1955



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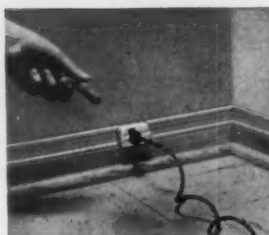
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Questions on the Code

Answered by

B. A. McDONALD, New York Board of Fire Underwriters, Rochester, N. Y.

GLENN ROWELL, Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.

B. Z. SEGALL, Consulting Electrical Engineer, New Orleans, La.

Motor Protection-Fractional H P

Q. Does Section 4322-c of the National Electrical Code require a switch with a thermal overload element rather than an ordinary toggle switch on a fractional horsepower heater fan motor which is controlled by a thermostat?—C.J.

A. Section 4322-c of the N. E. Code covers the requirements for the overcurrent protection of a motor, 1 hp or less which is automatically started; and Section 4402-b covers the requirements for the disconnecting means of a motor rated at 2 hp or less. Since the motor in question is automatically controlled, it must be protected by one of the methods outlined in Section 4322-c. Reference to this section shows that a separate overcurrent device which is responsive to motor current must be used in addition to the branch circuit overcurrent device. One of the methods recognized could consist of a combination switch and thermal overload element as covered by your question. The use of a switch alone, however, would not satisfy the Code unless a device capable of giving both motor branch circuit protection and motor running protection were used as covered by Section 4344. If, however, the motor was manually started and within sight from the starter location, the switch alone would satisfy the Code. In the February 1954 issue of EC&M, an excellent article, presented by L. D. Price, covered many of the details involved with the protection of motors.—B.A.McD.

Motors

Q. When a motor is placed in a grain elevator cupola and is normally operated from the control room located on the work floor and has a start and stop button within sight of the motor in the cupola, is it necessary to place a disconnect switch in the branch circuit supplying the motor to permit the motor being worked upon safely?—A.N.S.

A. No. The use of an additional switch within sight of the motor is not necessary provided the controller or its disconnecting means is capable of being locked in the open position. Section 4386 reads as follows:

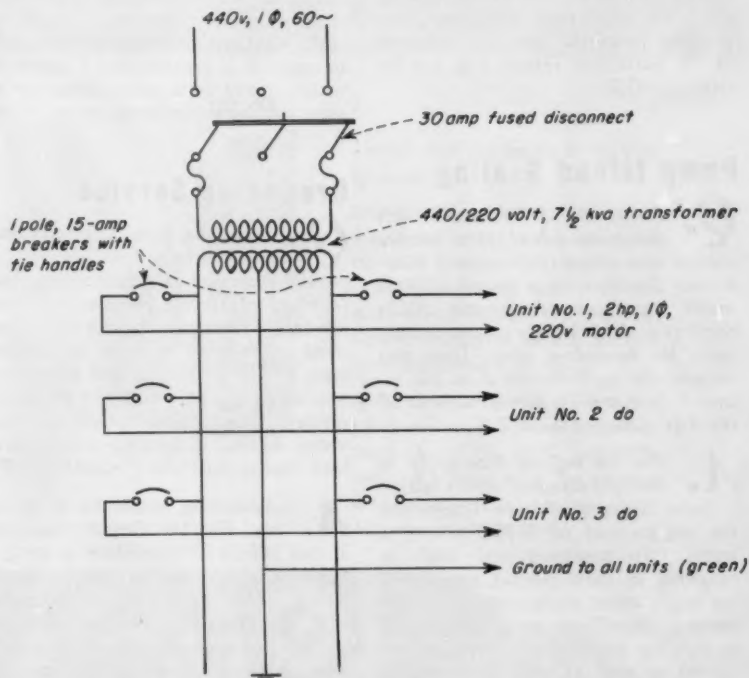
"A motor and its driven machinery shall be within sight from the controller location unless one of the following conditions is complied with:

a. The controller or its disconnecting means is capable of being locked in the open position.

b. A manually-operable switch, which will prevent the starting of the motor, is placed within sight from the motor location. This switch may be placed in the remote-control circuit of a remote-control type of switch."—G.R.

220-Volt Circuits

Q. Please advise if this wiring diagram for 220-volt refrigeration machine is in violation of the Code.—R.L.M.



A. No. I cannot see any code violation.

You may be interested in a very fine discussion of this problem to be found in the May 1955 News Bulletin of the IAEI. Mr. B. A. McDonald discusses "Air Conditioners in 230-Volt Circuits" but this applies equally as well to the refrigeration problem in your case.—B.Z.S.

Stage Cable Current Capacity

Q. In Chapter 10, Table 3, appears the current-carrying capacity of flexible cords. In what column would Type K (Stage Cable) appear if it were indicated.—W.A.H.

A. Section 5243 of the Code recognizes Type K cables for border lights and Section 5246 also recognizes it to supply portable equipment on a stage. Table 31 of Chapter 10 specifically recognizes Type K cable as a flexible cord suitable for

use on theatre stages. Section 4008 of the Code refers us to Table 3, Chapter 10 for the current-carrying capacity of flexible cords. Reference to this table shows that a Type K cord is recognized in column three with PO, C, PD, P etc. The current-carrying capacities given in this column would in my opinion apply to Type K (Stage Cable).—B.A.McD.

Wiring For Sound

Q. We are wiring a modern motel building of considerable size in which they wish to place four station radio speakers in each unit making it necessary that we run five conductors to each room to a selective switch and then to a speaker. Will the Code require that these conductors be placed in a metallic raceway, or may they be installed in the form of a cable?—J.L.G.

A. Under Section 6402 you will note that the wiring used for centralized distribution of sound such as you are installing in this motel may be installed in any of the wiring methods found under Chapters 1 to 4 of the Code. This same section also states that such installations shall comply with Article 725 of the Code. Therefore, you could use either the raceways or the cable and it would be my personal opinion that the design and construction of the building would in a way determine the type of wiring method which should be employed. Article 725 simply shows the type of insulation which must be employed depending upon the current limitation of the particular system you are installing.—G.R.

Pump Island Sealing

Q. Paragraph 5120b states that the pump island of a service station is a Class I, Division 1 Hazardous Location to a height of 4 ft above pavement. Paragraph 5015a requires seal-off fittings where circuits enter the hazardous area. Does this include the light standard on the island? Is a seal-off fitting required at the 4-ft elevation?—W.P.G.

A. Yes the sealing does apply to the light standard on the island. Some inspectors have interpreted the requirement of 5120f1 where it states "An approved seal shall be provided in each conduit run entering . . . other equipment on a dispensing island" to apply specifically to lighting standards. They have required a seal at this point where

the standard attaches to the dispensing island. Then in accordance with 5120f2 they have required a second seal at the 4-ft level to seal off the Class I, Division 1 area from the non-hazardous area immediately above this 4-ft level.

Most inspectors, however, have been satisfied with a single seal at the 4-ft level of the light standard.—B.Z.S.

Underfloor Raceways

Q. In a new office building being erected in this town, the plans call for two underfloor raceways to be laid down through the office, one for light and power outlets and the other for telephone and interoffice communication units. May these two raceways be laid side by side or must they be spaced some specified distance apart?—J.S.

A. Under Section 3543, you will note that unless these raceways are kept $\frac{1}{2}$ -in. apart, it will be necessary they be fastened together to form a rigid assembly. If the raceways are not more than 4 inches wide, they may be laid flush with the concrete floor surface provided that surface is covered with linoleum or other similar floor covering material which is at least $\frac{1}{4}$ of an inch thick. If the raceways are more than 4 inches wide, either individually or where they are separated by less than $\frac{1}{2}$ -in. making it necessary they be fastened rigidly together, the Code requires they be buried at least 1- $\frac{1}{2}$ inches below the surface of the concrete. Therefore, if the combination of the two raceways in question is greater than 4 inches in width, it will be to your advantage to separate them $\frac{1}{2}$ -inch or more.—G.R.

Grounding Service

Q. Sometime ago, I wrote and inquired as to whether I could ground a service to a cold water pipe (copper) at service entrance and put jumpers wherever there is a valve, instead of running a piece of ground cable almost 60 ft to a cold water entrance pipe ahead of meter. I put three jumpers around two valves and the water meter. According to Segall's book this is O.K. Am I right?—D.W.

A. According to the N. E. Code and also Mr. Segall's analysis of this rule, such procedure is recognized. It is important to note, however, that Section 2612 of the Code provides two requirements for the connection of the grounding conductor to a water pipe electrode. The first is on the

street side of the water meter and the second is on a cold water pipe as near as practicable to the water service to the building. Since the question of practicability must be decided by the Inspector, it is quite possible that various decisions may be given on this question. It is significant to note that the last sentence of this Section definitely recognizes the grounding of equipment to the nearest cold water pipe. This provision makes a distinction between the requirements for a system or common grounding conductor and one which only is used for grounding equipment.—B.A.McD.

Vaporproof Lighting

Q. How can an inspector determine if the vaporproof fixture offered by the manufacturer (100-500 watts sizes) meets the requirements of Section 5019b2 of the Code? I would recommend each vapor fixture be labeled giving actual wattage and temperature.—O.M.

A. It would seem that your suggestion would cover the situation. Maybe within time such markings can be included on the fixture nameplate.

In the meantime I suppose the burden will have to be with the prospective user to prove that the fixture he intends to use in a specific location will not reach a temperature in excess of that required by this Code rule. It is possible to make a quick and accurate check in the field to determine if a certain lighting unit will exceed a specific temperature. It is also possible that the fixture manufacturer can give the necessary information for his particular units if he is requested to do so.

Hazardous Dusts - Pulverized Orange Dust

Q. One of our customers has asked us to help him to determine whether or not the buildings in his plant should be considered a hazardous location of the Class 2, Division 1 or Division 2 types.

The building in question is a feed mill in a concentrate plant. In this particular building the skin or peeling of oranges or grapefruit is pulverized to a very fine dust which gradually deposits in thick layers over any flat horizontal surfaces in the building. They say that this dust does not seem to be explosive, but that they have noticed occasionally, apparently due to excessive heat, some of the dust will begin to smolder and burn very, very

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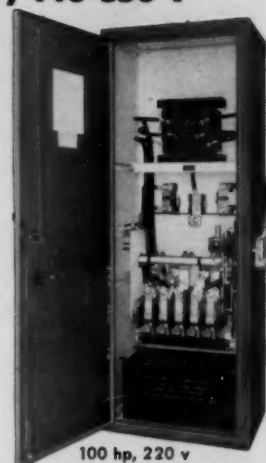
Air break contacts are standard for Sizes A, B, and C starters, but these starters can be furnished with oil-immersed contacts, where operating conditions require them. Only the Size D starter, rated up to 250 hp, uses oil immersed contacts. Write for Bulletin 646.

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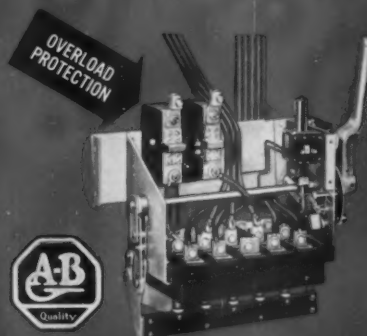
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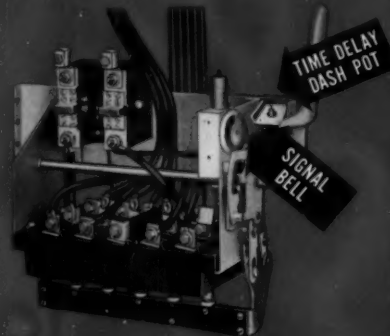
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autotransformer starter.



OVERLOAD PROTECTION—The Bulletin 646 autotransformer starter has two Bulletin 816 automatic reset thermal overload relays that assure dependable overload protection.

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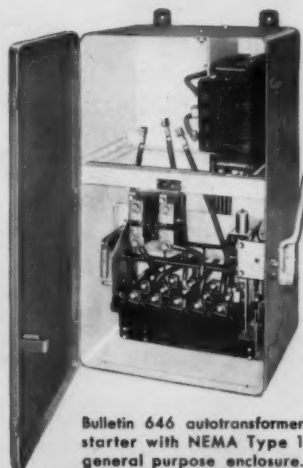
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justable dash pot can be set for 0 to 15 seconds.

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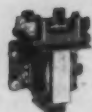
Bulletin 646 autotransformer
starter with NEMA Type 1
general purpose enclosure.

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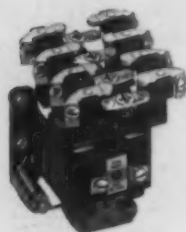
BULLETIN 646 AUTOTRANSFORMER STARTER



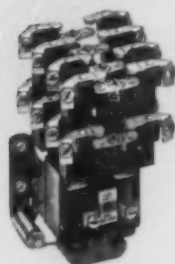
7-55-M



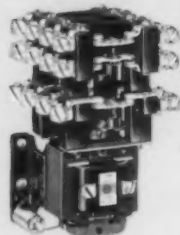
Type C-200 A-C
2-pole relay



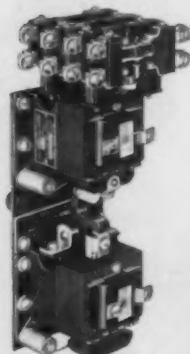
Type B-400 normally
open 4-pole relay



Type B-800 normally
open 8-pole relay



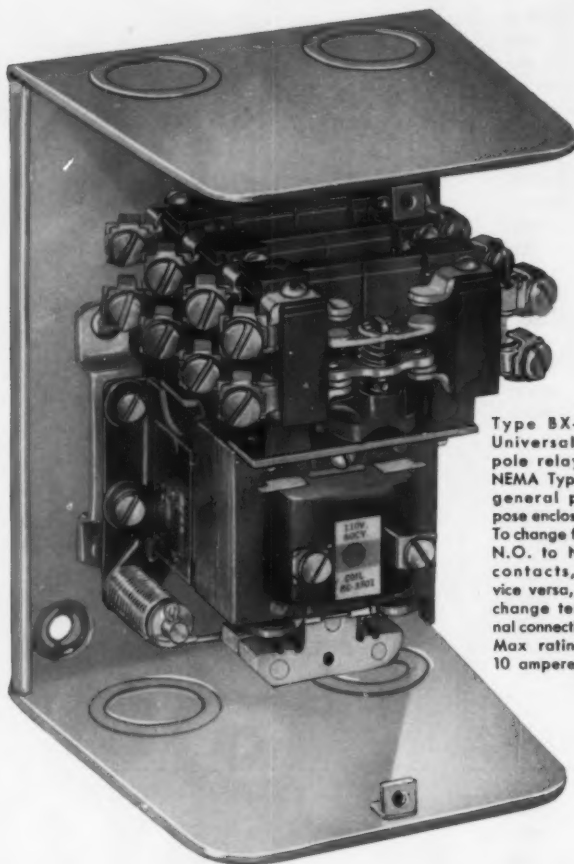
Type BX-840 universal
8-pole relay



Type BXL-440 uni-
versal relay with latch

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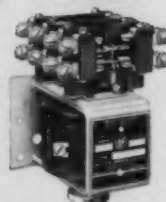


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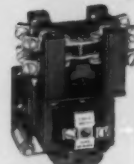
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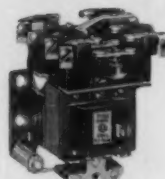
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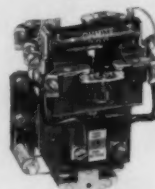
Type EX-440 D-C uni-
versal relay



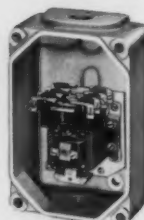
Type BX-220 universal
2-pole relay



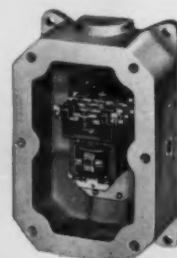
Type BM-200 mechan-
ically held relay



Type BA-20 2-pole
thermostat relay



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BULLETIN 700 RELAYS
QUALITY

slowly. Sometimes particles of this smoldering dust will fly around, and start some of the dust on another surface to smoldering as well. They are not sure whether the smoldering actually begins because of excessive heat, for example due to steam piping, or whether it is a case of spontaneous combustion.

What would your recommendation be as to the proper classification for this type of operations?—J.W.

A. In the absence of any definite information concerning the characteristics of the dust which develops when the skins of oranges or grapefruit are ground, it is difficult to fully answer your question at this time. Section 5005 of the N. E. Code covers many locations which are considered hazardous due to the presence of a combustible dust. What is a combustible dust? The Inspector who has the responsibility for answering this question should avail himself, as recommended in the fine print note of Section 5001, of the information which is available through the standards of NFPA. These standards cover many types of occupancies which are hazardous to various degrees due to the characteristics of the dusts which are involved. All of us are familiar with the hazards presented by grain, coal, coke or metal dusts and the Code under Article 500 definitely establishes the status of such dusts as combustible and provides for adequate safeguards when they are exposed to electrical wiring and equipment.

Occasionally however, as industry continues to progress, new sources of dusts arise for which standards have not been developed. There is no background of laboratory experiment to evaluate the degree of hazard or to guide the Inspector and I believe the case which you have presented comes under this heading. In such cases the Inspector should obtain a report covering the characteristics of the dust from a reliable and recognized source such as the National Fire Protection Association, the Underwriters' Laboratories or the Factory Mutual Laboratories. Many considerations are involved in evaluating the hazard inherent in a given dust, which may be reasonably answered by resort to laboratory tests conducted by personnel trained in this specialized field.

With this very brief background of the fundamentals involved, I would answer your question as follows:

1.—Obtain a report from the NFPA regarding the characteristics of orange or grapefruit dusts which are produced in the process of pulverization. I am sending a copy of this letter to Mr. R. S. Moulton, Technical Secretary of the NFPA with a request, in the

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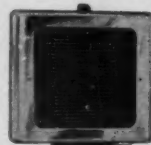
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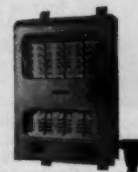
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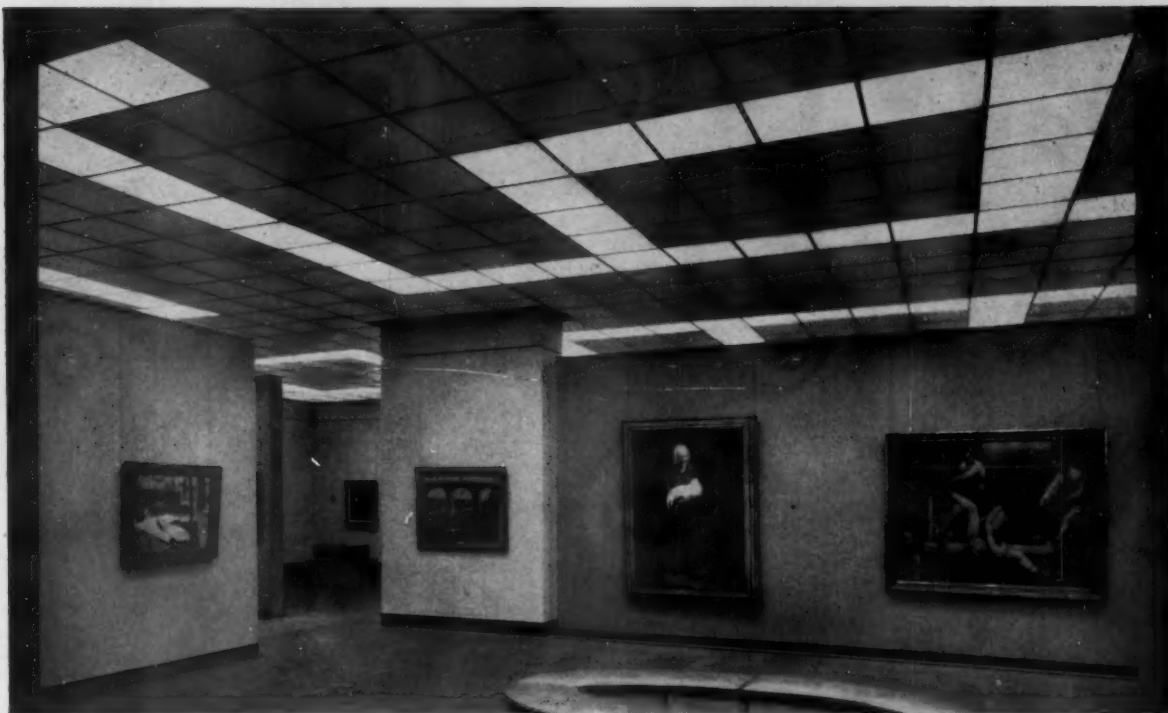
Circuit Breakers

absence of any definite information, that we be advised of the proper procedure for further action. Usually samples of the dust would be furnished the Laboratories. Such a report would definitely establish the status of such dust and promote the proper application of Article 500.

2.—While the explosive nature of the dust may be questionable in view of the many variables which usually are involved, it is quite definite from your letter that the dust has a low ignition temperature and burns slowly. It therefore appears to be combustible but we do not know at this time if when suspended in the air, in various quantities, whether it will or will not produce an explosive or an ignitable mixture. I believe we are correct in assuming however that this dust in the presence of electrical equipment would accumulate on or in such equipment and would interfere with the normal ventilation of such equipment and also be subject to ignition by the heat or the arcs and sparks from such equipment. It is therefore evident to safeguard this hazard, the electrical equipment so exposed should, at least comply with the requirements for a Class 2, Division 2 location, and other sources of ignition (non-electrical) should either be eliminated or isolated from this dust. If Laboratory tests show that the dust when suspended in the air under normal operating conditions will produce an explosive or ignitable mixture then the question of applying Class 2, Division 1, requirements should be considered for this installation.

It is quite possible that Mr. Moulton may be in a position to clarify the status of this dust in a few words, if not, I know that he will endeavor to assist in any way possible to obtain the correct answer to your question. In the meantime, I would recommend that the provisions of a Class 2, Division 1 location be satisfied and that some action be taken to eliminate the accumulation of this dust on any surface in the property.

Advice just received from the Bureau of Mines, U.S. Dept. of the Interior indicates, from a test made sometime ago, that the dusts from dehydrated citrus peel are quite explosive. The sample tested had a relative flammability of over 90, the ignition temperature of the dust cloud was 490° C., minimum explosive concentration was about 0.1 ounce per cubic foot of air and the pressure produced at a concentration of 0.5 ounce per cubic foot was about 50 pounds per square inch. They believe however that a test of the dusts under discussion should be made and suggest that a sample be forwarded to them.—B.A.McD.



In this painting gallery at the Whitney Museum, the panels of Alba-Lite are dimmed to show the location of the Fota-Lite panels. Louvers are photographically produced in Fota-Lite to transmit light at a 30° angle in this installation. Direct illumination on vertical surfaces at eye level totals 65 foot-candles. Fota-Lite also comes with louvers designed for 45° cutoff.

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Lighting Consultant: Thomas Smith Kelly

Fixtures: Century Lighting and Rem-lite, Inc.

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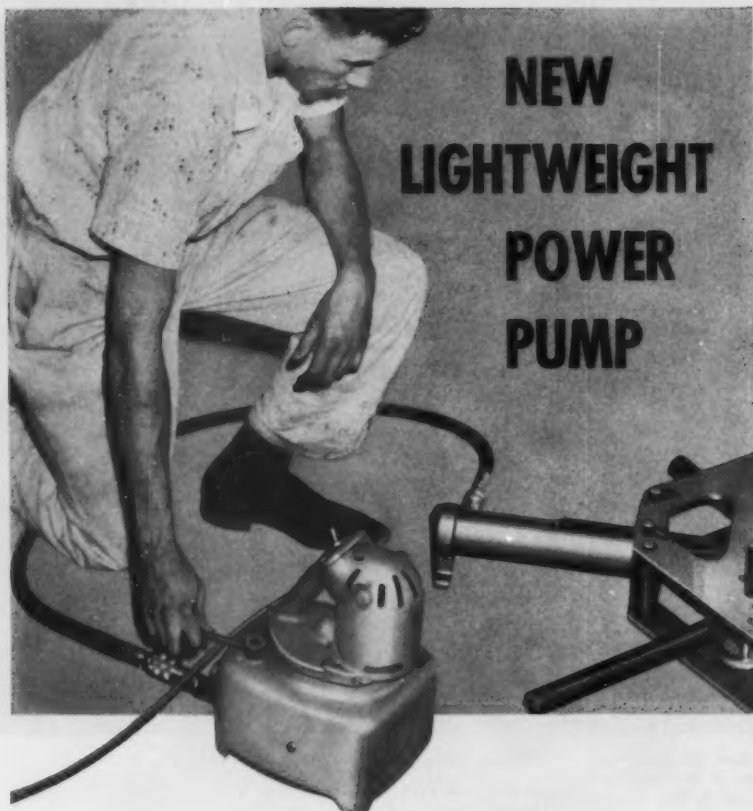
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Auxiliary Gutters

Q. I recently had occasion to inspect an installation where the workman had installed an auxiliary gutter which was T shaped. As the construction between the horizontal and vertical member of this gutter could not be considered a rounded edge, I have insisted that they provide a rounded sheet of insulating material permanently fastened into this gutter to protect the insulated conductors where they pass from a vertical to the horizontal sections. Is this not provided for by the Code?—S.T.H.

A. Yes, under Section 3749 you will find in paragraph c. the requirement which backs up your action. It here states: "Suitable bushings, shields or fittings having smooth rounded edges shall be provided where conductors pass between gutters, through partitions, around bends, between gutters and cabinets or junction boxes and at other locations where necessary to prevent abrasion of the insulation of the conductors." Whenever auxiliary gutters are made up especially for some specific job, the contractor can save money if he will have the metalworker eliminate all sharp corners or edges at bends or angles in these gutters.—G.R.

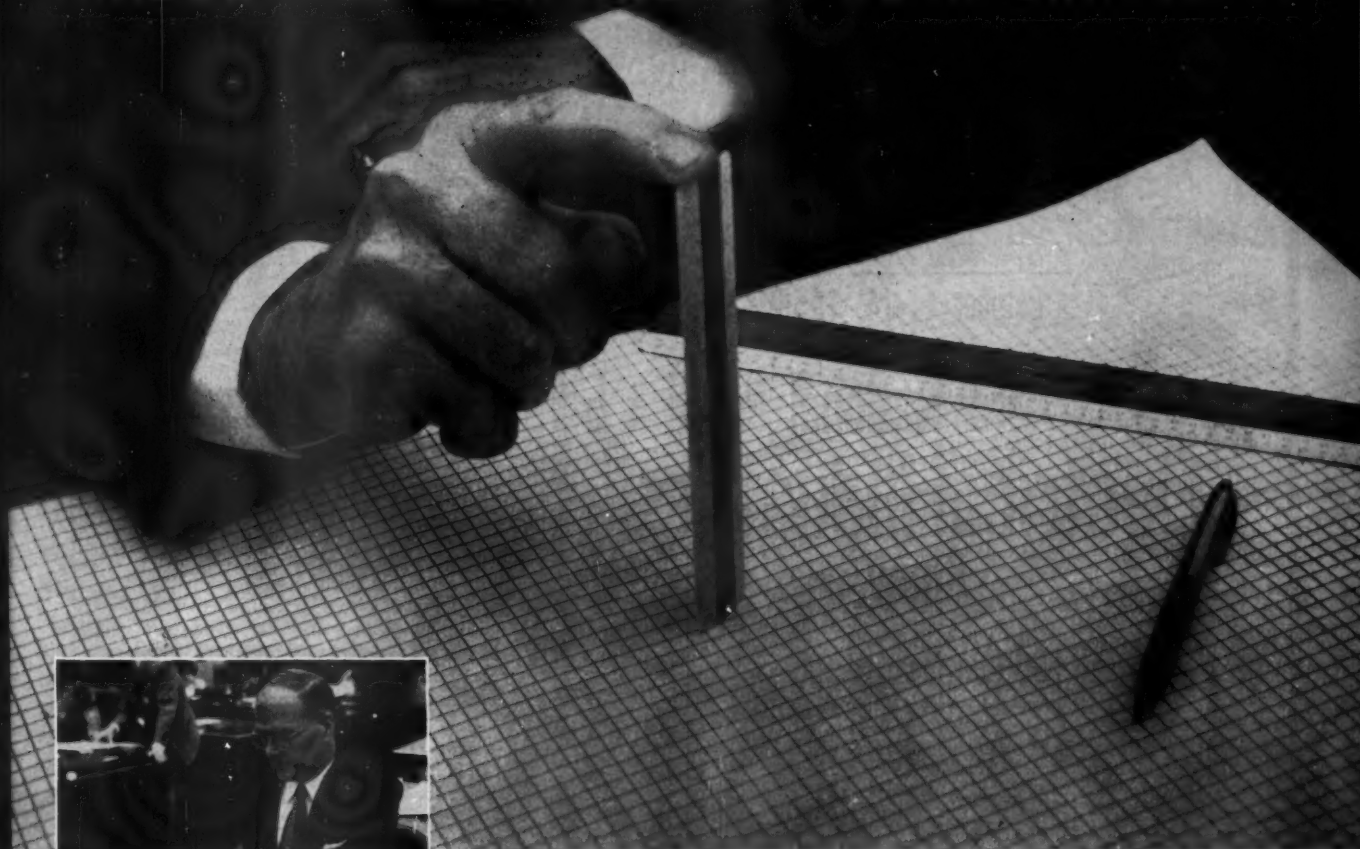
Hospital Operating Rooms

Q. I would like your opinion on using a single pole integral sealed explosion-proof switch and pilot located 5 ft 3 in from floor to bottom of case in an operating room for controlling line current on the germicidal lamps located in the intake duct of the air conditioning system. The current this switch operates is taken from the branch circuit panel of the isolating transformer and has a 2-pole switch located at the germicidal lamp in the duct plus the usual 2-pole circuit breaker at panel.

There seems to be a difference of opinion on these particular switches as they are set above the described hazardous area (5 ft) but are still in an area using conductive flooring and are fed by the isolated panel. The lamp has the 2-pole switch located very near it but the other four switches and pilots located in each operating room are single pole. Should they be double pole or is this single pole satisfactory?—C.M.A.

A. Section 5135 of the Code classifies the operating room of a hospital as a Class 1 Division 1 location which extends upward to a level

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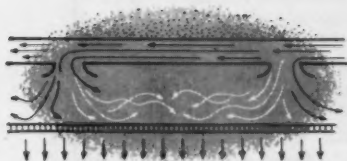
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MURRAY HILL 7-4580

of 5 ft. above the floor. I believe this classification is influenced by the ventilation of the room as covered by NFPA pamphlet No. 56 covering "Safe Practice for Hospital Operating Rooms." Section 5135-d-2 of the Code covers the equipment which may be used in the operating room above the 5-ft. hazardous area. Since the switch and pilot, in which you are concerned, is located 5 ft 3-in. above the floor, it appears that this section applies and it would not be necessary to apply the provisions for a hazardous location as covered in Article 500. Since the wiring above the hazardous area must be installed in metal raceways or Type MI cable, it is apparent that the switch enclosure would be grounded as required by the general rules of Article 250. While Section 5135-f requires all circuits in the operating room to be ungrounded and fed from a source that is isolated from the distribution system serving the hospital, there is no provision that prohibits the grounding of wiring raceways or equipment used with the isolated ungrounded system. In fact Section 5135-i requires such grounding when the equipment is located in a hazardous area.

Insofar as the conductive flooring is concerned, reference to NFPA pamphlet No. 56, Section 6, shows the design of this flooring is such that it will dissipate static electricity and prevent the accumulation of dangerous (electrostatic) charges and at the same time provides only a moderate degree of conductivity between persons and equipment in contact with the floor. It therefore safeguards the electric shock hazard presented by the old method of procedure which recognized a grounded flooring with very low resistance. Full details are covered in pamphlet No. 56 which may be obtained from the National Fire Protection Association, 60 Batterymarch Street, Boston 10, Mass. for 25 cents.

Section 5135-f requires each circuit within or partially within the operating room to be controlled by a switch having a disconnecting pole in each circuit conductor. It is my opinion that this requirement would only be satisfied by a double pole switch located on each circuit at the panel. The status of supplementary switches such as the switch at the lamp and the control switch is not covered and I am inclined to believe that if they were single pole switches and the entire circuit was controlled by a double pole switch, there would be no Code violation. There appears to be a little conflict with Section 5-10 of NFPA No. 56 which only requires double pole switches in hazardous locations that control lighting circuits.—B.A. McD.

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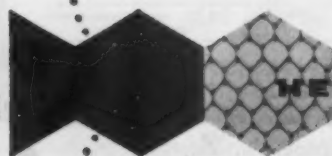
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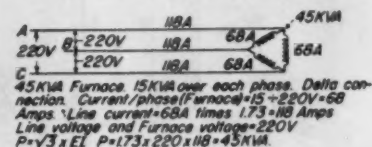
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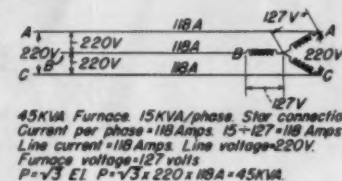
Three-Phase Furnace Currents

Q. Will you clarify a question in my mind which concerns the method of computing wire, switch and fuse sizes when wiring a 45-kva 3-phase electric furnace (3-wire, delta or star). How do you compute these values?—G.R.

A. In the absence of any line current values shown on the nameplate of the furnace, I would compute same as shown on the illustration. I am assuming that the voltage of the circuit is 220-volt and that the furnace is a non-inductive load.



The first sketch shows a delta connected furnace. In this case the current in the line is equal to 1.73 times the current used by each phase of the furnace. The line voltage and the phase voltage in the furnace are the same.

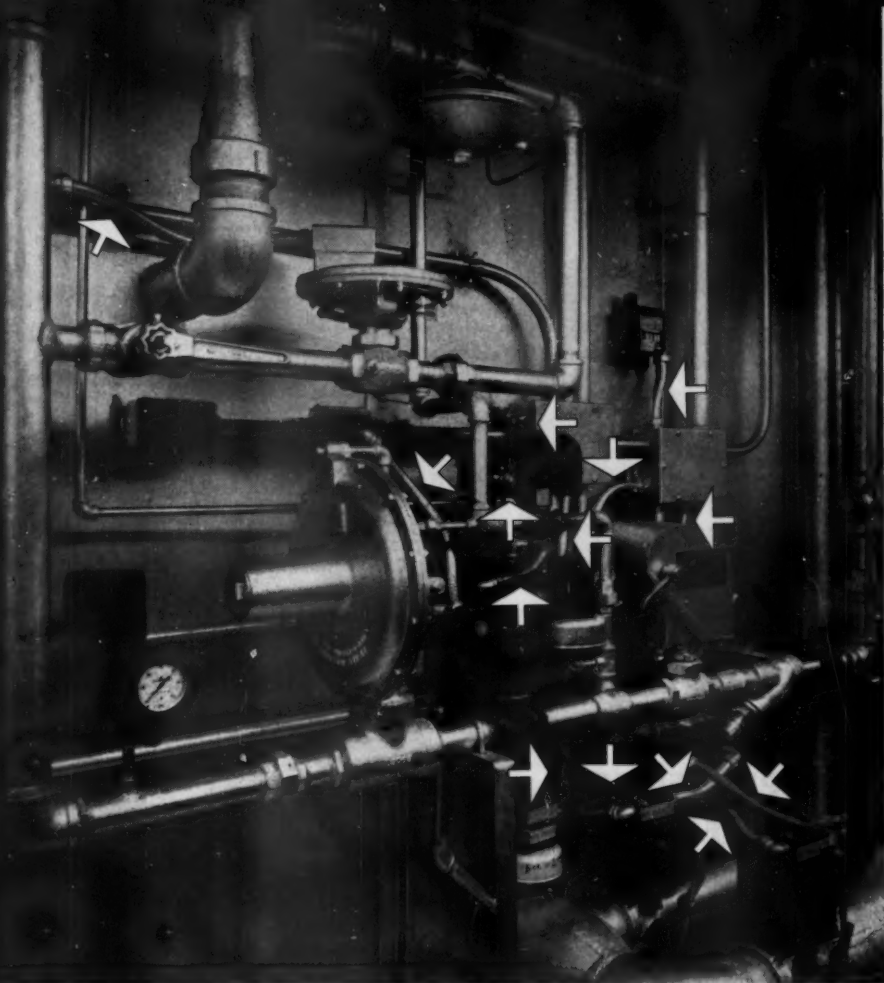


The second sketch shows a wye-connected furnace. In this case the current in the line and each phase of the furnace is the same. The voltage of the line however is equal to 1.73 times the voltage over each phase of the furnace. It is evident that the resistance units in the wye connection are of a lower value than those in the delta connection. In other words you could not connect the same furnace either wye or delta and obtain the same heating effect. If this does not cover what you have in mind, let me know.—B.A.McD.

Junction and Fixture Boxes

Q. Rule 3717 requires junction boxes to be accessible. Can this box be used for fixtures also as per rule 3917? This is between floors and ceiling in a church.—L.P.F.

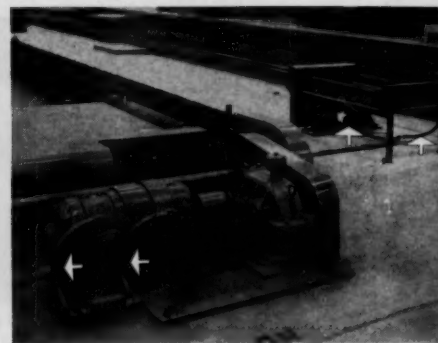
A. I see no reason why the junction box cannot be used for hanging fixtures. This type of construction is in fact used quite exten-



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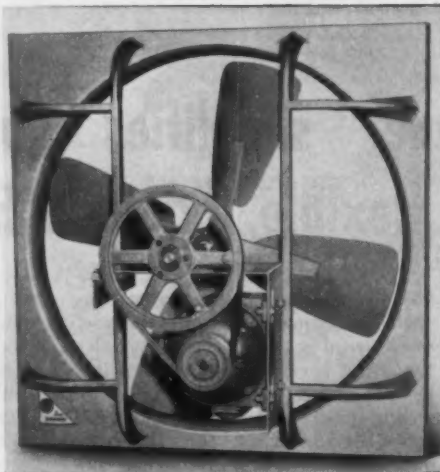
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sively. In most cases, the fixture may have to be removed before the junction box is made accessible. The removal of the fixture is usually accomplished without removing any part of the building, except, maybe, in some special cases where a fixture is designed as a specific part of the building. Even in these cases it is still possible to install the junction box as required by Section 3717, as for example, expediting access to the box through accessible attic space.—B.Z.S.

Running Conductors over a Roof

Q. The National Electrical Code under Section 7324 states that a roof which cannot readily be walked upon may have conductors running over it if they are three feet or more above the roof. Therefore, when a roof has no ready access to it, such as by stairs, fixed ladder, or openings from an adjacent building, does it qualify under this section?—A.P.M.

A. No. Section 7324 refers solely to the angle of slope of the roof and not to the means of access to the roof. In other words, the inspection authority having jurisdiction must determine whether the slope of the roof is such that it cannot be readily walked upon in an upright manner, and wherever a roof may be walked upon in an upright manner, whether or not there are fixed ladders or stairs, wiring extending above that roof must be at least eight feet above the high part of the roof. Official interpretation No. 400 covers this section of the Code as far as access to the roof is concerned. However, as yet it is necessary for the authority enforcing the Code to decide when the angle of a roof slope is such that it cannot be readily walked upon.—G.R.

Service Disconnect on Pole

Q. I have a question of interpretation of Section 2351 of the National Electrical Code. In this particular instance we have wired a service station using a 20-circuit N.T.P. type fuse panel. Because the service is underground, the Power Company required us to install a weatherproof fused disconnect at the pole where the meter and underground service starts. Is it also necessary for us to install another main disconnect at the building ahead of the fuse panel?—H.L.D.

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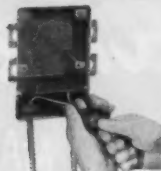
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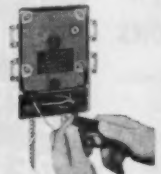
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2.



Screw control assembly to wallbox.

3.



Connect circuit leads to color-identified control leads.

4.



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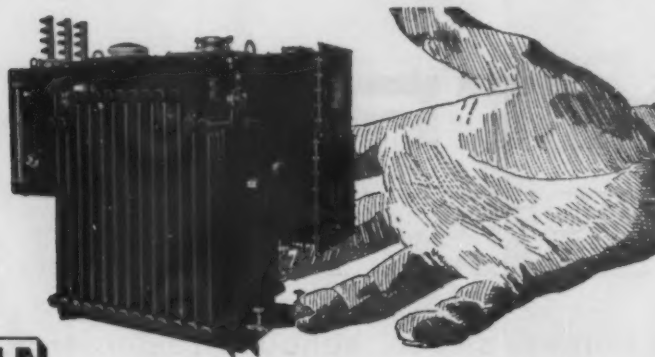
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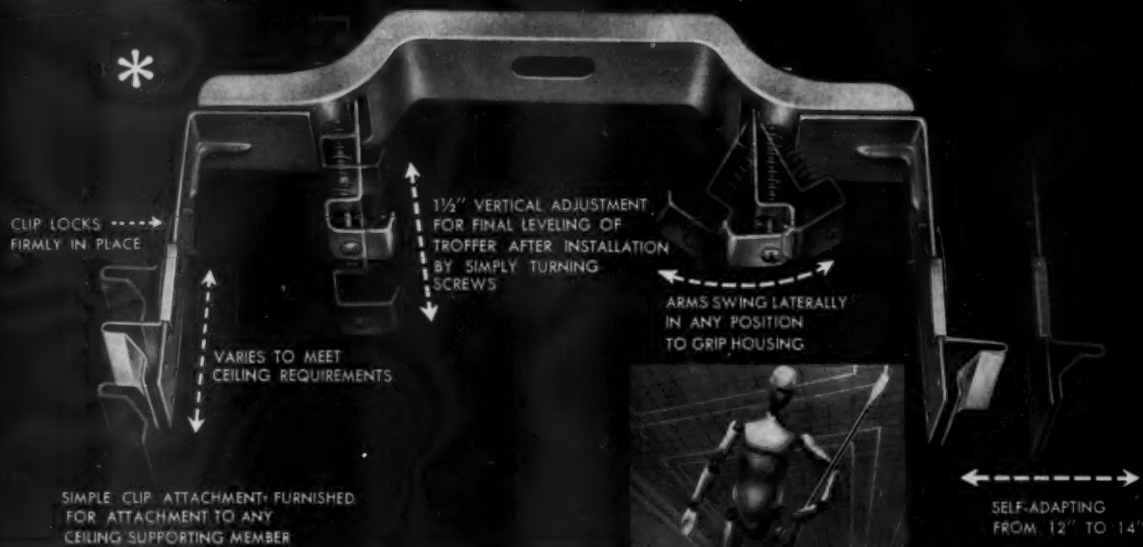
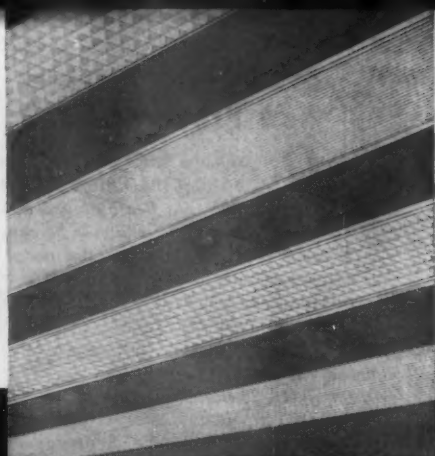
#500 MCM #6

A. The question which you have raised appears to be similar in some respect to that presented by some farm installations. In such cases the overhead service is brought to a yard pole located on the farm property, where a meter and sometimes a fused service switch is installed. When the service switch is so installed it appears obvious that the conductors from the pole to the building or buildings served are both controlled and protected and the service to the property terminates at the service equipment. The fine print note following the definition indicates that service equipment may be located outside the building walls. It reads as follows: "Where service equipment is located outside the building walls there may be no service-entrance conductors, or they may be entirely outside the building." The fine print note following Section 2304-b also recognizes the use of service equipment on a pole and provides, in the case of overhead conductors from the pole to a building, that they be installed as required for service drop conductors. Section 3351-d provides however in a building comprising more than one building under single management, that the conductors supplying each building served shall be provided with a readily accessible means, within or adjacent to the building, of disconnecting all ungrounded conductors from the source of supply. An Official Interpretation on this rule indicates that a switch located at either end of the feeder would satisfy this requirement.

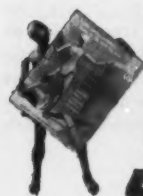
In view of this background of rules which are involved, it appears to me that the fused service switch installed on the pole would satisfy the requirements for the service disconnect and overcurrent protection and also satisfy the requirements of Section 2351-d. It should be noted however that this disconnecting means must be "readily accessible". See definition.

While the foregoing appears to cover the pertinent rules involved, it is quite possible that the conditions concerned with a service station could be different than the conditions on farm properties. Is the pole located on the owner's property? Is the service equipment the property of the owner? Is it readily accessible? Is the Service Station in a congested area? Is it accessible to the public? These and other considerations are also involved in making a decision. If it is readily accessible to the public or inquisitive children, it should be locked and if it is locked, there could be a question of accessibility. Under such conditions I could only recommend that a disconnect be installed inside the building.—B.A.McD.

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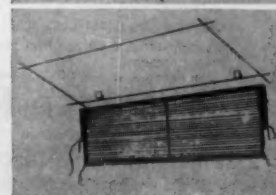
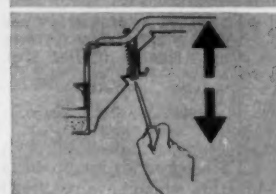
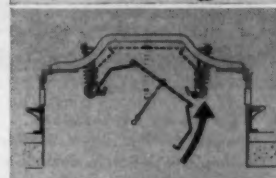
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**Grounding Portables
New Provisions**

Q. As of January 1, 1955, Section 4010 of the National Electrical Code requires a flexible cord containing a grounding conductor be equipped with a grounding type attachment plug cap. Have "Standard" type caps and receptacles been recommended or adopted by the Code, NEMA, or any other association, for the various amp and voltage ratings?

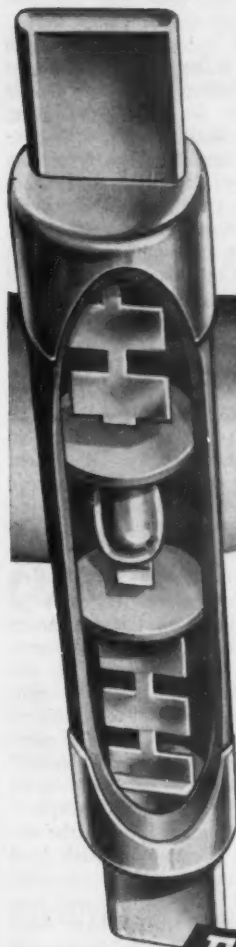
On 20-amp, 120-volt circuits I have used 3-pole Twist-lock type receptacles through 1949, now I am specifying the 3-pole receptacle with parallel and U-shaped grounding slots. What types of caps will appliance and portable equipment now be furnished with in the 20-, 30- and 50-amp, 120- and 240-volt ratings?—M.W.F.

A. According to Section 2559 a and b of the Code, portable equipment, which is required to be grounded by Section 2545, may be grounded either through the metal enclosures of the conductors feeding the equipment, or by a grounding conductor run with the circuit conductors provided an approved plug is used and has one fixed contacting member for the purpose of making the necessary connection.

Section 4164 of the Code describes a grounding type receptacle and Section 4165 covers the requirements for the plug caps to be used with such receptacles. It is significant to note from these requirements that the grounding type of receptacle is limited to a maximum rating of 15 amps and 150 volts. I mention this point since advertising material indicates that such grounding receptacles are approved by Underwriters' Laboratories with ratings of 250 volts. At the moment I am unable to explain this apparent conflict with Code requirements. It is also important to note from Section 4165 that the grounding member of the cap must be so designed as to prevent it making contact with either of the current carrying contacts of the receptacle, and shall be of a distinctly different appearance from the other two terminals. Various designs could be used to satisfy these requirements and it appears at the present time that the U-shaped grounding slot design with similar cap members have been accepted by the Industry as a standard.

Section 2123 b of the Code also enters the picture. It reads as follows: "Receptacles connected to circuits having different voltages, frequencies or type of current (ac or dc) on the same premises shall be of such design that attachment plug caps used on such circuits are not interchangeable. Ground-

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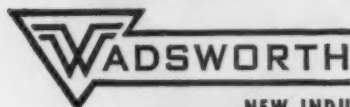
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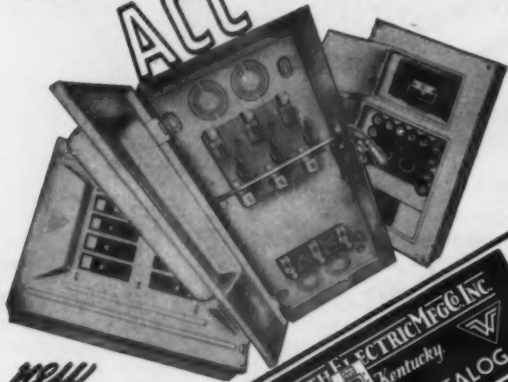
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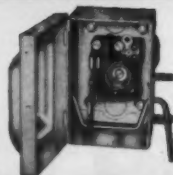
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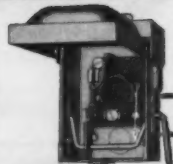
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ing receptacles installed in circuits of less than 150 volts between conductors shall be approved for use only on potentials less than 150 volts." This last sentence infers that a grounding type of receptacle could be used on circuits with a voltage of more than 150 volts to ground which appears to conflict with the requirements of Section 4164.

As covered in your letter, Section 4010 requires a flexible cord that contains a grounding conductor and is equipped with an attachment plug, that the plug shall comply with Sections 2559 a and b. This provision, already covered, requires the use of the grounding type plug. There is no limitation with respect to amperes or voltage so the rule applies generally.

With this Code background I will now endeavor to answer your questions. Insofar as the Code is concerned, no standards for satisfying the foregoing requirements have been set-up. Such standards are usually covered by U.L. and the ASA. The Underwriters' Laboratories have established standards for equipment rated 15 amps or less which I believe may be summed up with the following quotation from a U.L. report issued during the past year; (Bi-Monthly Supplement December 1953) "During 1954 the Laboratories will make a review of all listed electric appliances using grounding types of attachment-plug caps on their supply cords, and all the manufacturers of such appliances will be expected to eliminate entirely from the supply cords in question before January 1, 1955 "pigtail" type caps and the 3-pole caps mentioned in the preceding paragraph.

Beginning January 1, 1955, the existing types of 15-amp caps with fixed male grounding members (parallel blades for 125 volts or less, and tandem blade for 250 volts) have been the caps to be used with electric appliances rated at 15 amps or less. For appliances rated at more than 15 amps, existing 3-pole caps with appropriate current and voltage ratings continue to be acceptable for grounding connections.

The following advice has just been received from Underwriters' Laboratories, Inc. of New York City.

"On Page 2 of your comments you refer to Section 2123b of the Code. The conflict which you describe does exist and, actually, the reference should be to 15 amps, or less, 150 volts or less, if the actual possibilities of enforcement are realized. There is no receptacle rated at more than 15 amps available to satisfy the conditions of Section 2123b as well as 4164 and 4165, simultaneously.

"Briefly, we have simplified our present acceptances as follows:

"The so-called 'pigtail' ground on a parallel-blade cap is no longer recognized.

"The American Standard parallel-blade grounding acceptable (rated 15 amps, 125 volts) and its corresponding plug are the only devices recognized for grounding equipment with a 2-wire supply within the rating limitations of the plug and receptacle and where a portable device is to be connected by means of a cord and plug.

Otherwise, because of the limited number of receptacles available, the Laboratories is prepared to accept any reasonable arrangement of plug and receptacle grounding beyond the 15-amp, 125-volt rating of the American Standard parallel-blade grounding plug just mentioned.

"This subject can easily be complicated by too much discussion and I hope we have not confused your thinking with the above comments. Actually, your understanding of the subject in its overall picture is exactly the same as ours."—B.A.McD.

Valance Lighting

Q. May ordinary neon tubing supplied by 12,000-volt neon transformers be used for valance lighting in a dwelling?—B.K.W.

A. Section 4183 of the National Electrical Code definitely forbids such an installation as it states that open circuit voltage in excess of 1,000 volts shall not be installed in dwelling occupancies.—G.R.

Fixtures for Hospital Operating Rooms

Q. We understand an Official Interpretation of lamp surface temperatures as required by Section 5019b2 and as applicable to hospitals by rule 5135c1, limits the lamp size to 150 watts. Does that mean a fixture designed as an operating light, suspended from the ceiling with a 350-watt lamp is a violation?—R.E.C.

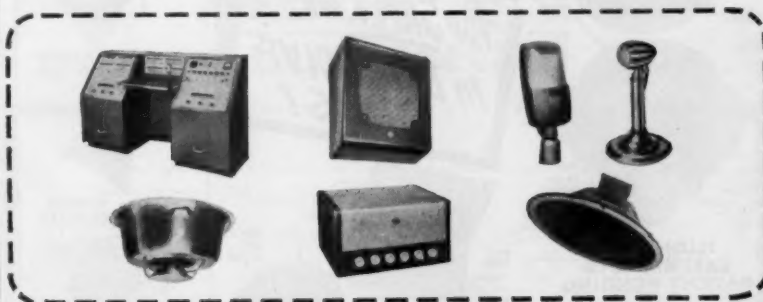
A. I have no knowledge of such an Official Interpretation. It would seem that each manufacturer's fixture would have to be tested for the maximum size lamp to produce this top temperature. While it might be possible to limit the maximum size of lamp for all manufacturers it seems hardly probable that each manufacturer's design would give the top temperature for the same size lamp.—B.Z.S.



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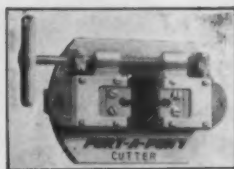
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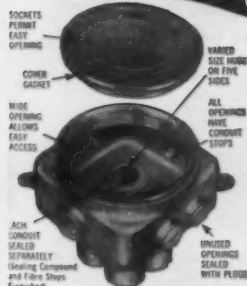
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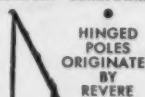
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Grounding

Q. In the grounding of the conductive exterior of fixtures, cabinets, boxes and the like of an electrical installation, does a contractor fully comply with the requirements of the Code when the grounding means he employs has a resistance of less than 25 ohms as is stated under Section 2584 of the Code?—C.M.

A. The compliance with Section 2584 does not necessarily assure compliance with Code requirements as you will note if you refer to Section 2551 that "The path to ground from circuits, equipment, or conductor enclosures shall be permanent and continuous and shall have ample carrying capacity to conduct safely any currents liable to be imposed on it, and shall have impedance sufficiently low to limit the potential above ground, and to facilitate the operation of the overcurrent devices in the circuit." In order to comply with this latter requirement, it is rather obvious that a grounding electrode operating at a resistance of 24 or even 20 or 15 ohms cannot be used for the grounding of cabinets, fixtures or other equipment and comply with the Code because it cannot permit sufficient current to flow to open the 15- or 20-amp overcurrent protective device protecting the circuits supplying this equipment. If you will read the fine print note following Section 2584, you will notice the recommendation there to make a direct connection between the grounding conductor and the utility neutral on the supply side of the service disconnecting means and in most instances unless this interconnection is made, the value of your grounding is limited solely to protection against lightning surges or other high voltage which might be impressed through fault upon the electrical installation. There are, of course, some locations where grounding electrodes will have resistances to earth sufficiently low so impedance on this grounding path will be low enough to permit sufficient current to flow to open the overcurrent protective device on the circuit. These instances, however, will be very few and far between as a circuit operating at 118 volts potential will not open an overcurrent protective device rated at 15 amp should it fault unless that fault permits the flow of at least 110% of the rating of the overcurrent protective device, and dividing rated voltage by rating of overcurrent protection indicates that resistance of this fault must be less than $7\frac{1}{2}$ ohms.

As most public utilities, R.E.A. Cooperatives and municipal systems today operate with a grounded primary distribution, with the neutrals between

the secondary and primary systems interconnected, it is common to find resistances to earth on this neutral with values of less than $1\frac{1}{2}$ ohms. In fact, in many cities these resistances drop as low as a fraction of one ohm. Therefore to assure that proper operation of overcurrent protective devices in the event of insulation failures, an interconnection should be made between his grounding conductor and the utility neutral.—G.R.

NEC Official Interpretations

Seven official interpretations of the 1953 National Electrical Code have been reviewed and recently released by the Electrical Correlating Committee of the National Fire Protection Association. These are in addition to the official interpretations of the 1953 Code previously released and will be included in the 1955 edition of the National Fire Codes, Vol. V, Electrical to be published by the NFPA, September 1955.

Subjects covered by the new interpretations include mechanical protection of service entrance cable and conductors, additional service, auto-transformers, service disconnect means, use of relays, service to separate buildings, and open spar wiring.

The official texts of the interpretations are as follows:

Interpretation No. 417

ARTICLE 230; Mechanical Protection Service Entrance Cable and Conductors

Statement: Approved service entrance cable is used to supply a low single story residence and in order to comply with the provisions of Section 2324 a mast or pipe-riser is used from the outdoor meter enclosure to a point some three feet above the roof of the building.

Question No. 1—Under the provisions of Sections 1101, 1102, and 2331, would it be permissible to use galvanized water pipe for mechanical protection of the service entrance cable between the watthour meter enclosure and the top of the mast?

Answer—Yes.

Question No. 2—If individual conductors constituted the service conductors would galvanized water pipe be acceptable as the mechanical protection?

Answer—No.

Interpretation No. 418

ARTICLE 230; Additional Service

Statement: In a single occupancy building, service entrance conductors are run from the utility watthour meter enclosure to the building service



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entrance equipment. It is necessary to increase the current carrying capacity of the service entrance conductors in order that they may be adequate to serve the load of the occupancy.

Question: Do Sections 2301 and 2305 permit the running of an additional set of service entrance conductors between the watt-hour meter enclosure and the service entrance equipment in order to provide additional current carrying capacity?

Answer—No.

Interpretation No. 422

SECTION 2003; Auto-Transformers

Statement: The questions concern the use of auto-transformers on poly-phase systems (of 208 volts or higher) to derive higher or lower potentials on unidentified systems.

Question No. 1—Is it the intent of Section 2003 to prohibit the use of auto-transformers to derive a 2300-volt, 3-phase, 3-wire supply from a 4000-volt, 3-phase, 4-wire grounded neutral system?

Answer—No.

Question No. 2—Is it the intent of Section 2003 to prohibit the use of auto-transformers to derive a 230-volt, 3-phase, 3-wire supply from a 208-volt, 3-phase, 4-wire grounded neutral system?

Answer—Yes.

Question No. 3—Is it the intent of Section 2003 to prohibit the use of auto-transformers to derive a 460-volt, 3-phase, 3-wire supply from a 575-volt, 3-phase, 3-wire system, or vice-versa?

Answer—No.

Interpretation No. 423

SECTION 2351; Service Disconnect Means

Statement: A piece of service equipment consists of an enclosure, three main circuit breakers and ten branch circuit breakers supplied through one of the main circuit breakers. The main circuit breaker supplying the ten branch-circuit breakers is of sufficient capacity for the load supplied by the ten branch-circuit breakers. There is no question as to the location of the service equipment with respect to ready accessibility near the entrance of the conductors. The three main breakers are marked to indicate that they are the service disconnects.

Question: Does such a device comply with the intent of paragraph "a" of Section 2351 of the 1953 edition of the National Electrical Code?

Answer—Yes.

Interpretation No. 424

SECTION 5024; Use of Relays

Statement: In a Class I, Division 2

location in a petroleum refinery, hermetically sealed relays of the plug-in type are contemplated in connection with an electric alarm system. When trouble is experienced on the alarm system, it is customary to pull out the hermetically sealed relays and insert new relays while the system is energized.

Question: Would the use of such relays be judged to comply with subparagraph 1, paragraph "b", of Section 5024 of the 1953 edition of the National Electrical code?

Answer—No.

Interpretation No. 425

SECTION 2321; Service To Separate Buildings

Statement: An addition is being made to an existing school building. The buildings are separated by a fire wall with fire doors. There is an 18-foot passageway between the two buildings constructed over steel frames.

The existing power supply is located across the existing building from the addition (some 300 feet distant) and is not adequate to serve the additional load.

If the existing service equipment were used to supply the new building, the conduit run would have to be through or around the existing building and the cost would be extremely high.

The local Building Department for zoning and other local reasons classifies the addition as a part of the original building rather than as a separate building.

Question: Would a new primary, transformer, and service drop located adjacent to the new addition be in accordance with the intent of the Code either on the basis of the addition being a separate building or under the provisions of paragraphs "c" and "d" of Section 2321?

Answer—Yes.

Note: Under this interpretation each building is considered as a separate unit electrically and there should be no electrical interconnections between them.

Interpretation No. 426

SECTION 7322; Open Span Wiring

Question No. 1—Is paragraph "b" of Section 7322 intended to apply to open wiring in used car lots?

Answer—Yes.

Question No. 2—If it is judged that the requirement with respect to the separation of conductors of open spans outdoors is applicable to the wiring in used car lots, would that prohibit the use of pin-type lampholders that fasten to the open conductors and thereby reduce the 12-inch spacing?

Answer—Yes.

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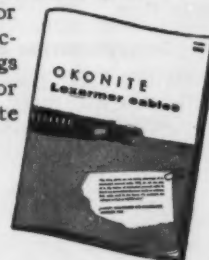
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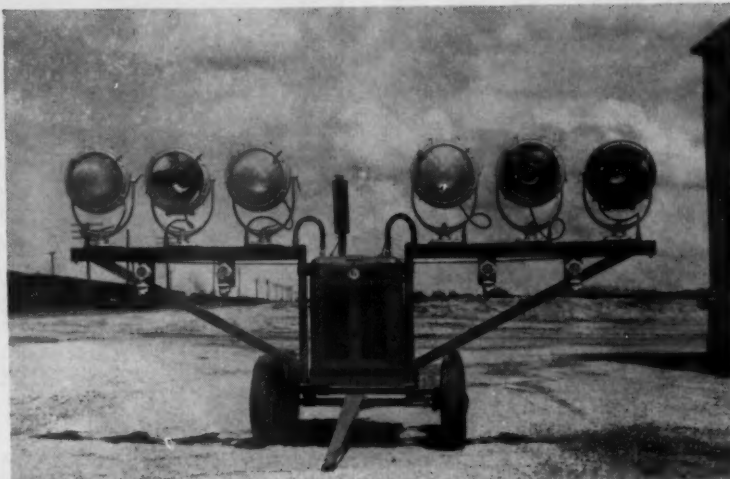
MAINTENANCE

Portability is the key to the efficient floodlighting used at Sohio Petroleum Company, Covington, Ky., to provide safe, adequate lighting during cleaning or repair operations of refinery storage tanks and other structural equipment. Designed by T. L. Clift, Electrical and Instrument Engineer at the Covington refinery, two portable floodlighting setups are extensively used.

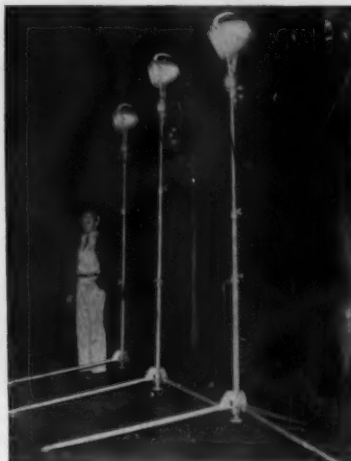
For emergency lighting and as a source of illumination for general outdoor maintenance work, Sohio employs a 7.5 kw portable generator equipped with six non-explosion-proof Crouse-Hinds floodlights. Three floodlights on each side of the generator are mounted on wing girders. By positioning the portable power unit between two refinery tanks, and leaving the wing girders in a closed position, lighting is provided for two maintenance crews. By swinging the girders out a full 90 degrees, a lighting bay is formed that delivers 35 footcandles of light over the surface of an object 50 ft away. The three wide beam floodlights deliver 5 footcandles of light over an area 60 by 60 ft; and the three narrow beam units produce 30 footcandles of illumination over an area 20 by 20 ft. This combination illuminates the entire side of a refinery tank by providing adequate lighting in the general work area, as well as by pinpointing extra light over specific repair areas. Floodlight elevation angle is adjusted by loosening and resetting the trunnions of each floodlight.

The generator also is equipped with four explosion-proof plug receptacles to feed power to other electrical equipment at the refinery, such as the battery of four explosion-proof floodlights used during cleaning operations to illuminate the interiors of refinery tanks. To provide extra strength and durability, type EC flexible couplings, Condulets and rigid conduit connect the plug receptacles to the generator's outlet circuit.

When in use, refinery tanks at Sohio contain crude oil and petroleum products, such as kerosene and naphtha. Ranging in size from 20 to 100 ft in diameter and from 20 to 50 ft high, the tanks are regularly cleaned, inspected and repaired.



PORTABLE GENERATOR equipped with six large floodlights and four type FSQ receptacles provides emergency lighting and serves as light source for outdoor maintenance work in non-hazardous areas at Sohio Petroleum Co. plant, Covington, Ky.



EXPLOSION-PROOF FLOODLIGHTS used to light interiors of Sohio refinery tanks during cleaning and repair operations are approved for use in Class I, Group D hazardous locations. Units are mounted on aluminum tubing tripod for portability, and powered by portable generator outside tanks.

Ordinary floodlights are not used, due to the volatile air-solvent mixture still present in the tanks after emptying but before cleaning. The explosion-proof floodlights provide safe illumination during these maintenance operations. Approved for use at Class I, Group D locations, the cast aluminum fixtures are sturdy yet light in weight. Each floodlight is mounted

on an aluminum tubing tripod that supports the floodlight 5½ ft above the ground when retracted and 10 ft when extended.

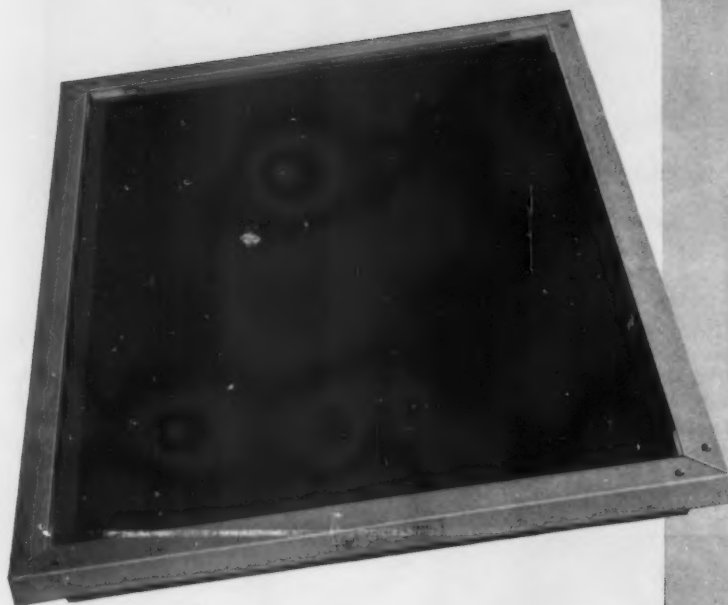
Outside the tank, power to the floodlights is fed by cable from the portable generator through a man-hole in the top of the tank. The leads to the floodlights are vulcanized to the generator cable. This arrangement prevents the lead wires from dragging along the tank floor or from tripping the workmen.

By arranging a battery of four floodlights in the center of the tank floor, workers can thoroughly wash down one wall section at a time. After the wall section is cleaned, intensity of the floodlights is high enough to allow the section's seams to be thoroughly inspected and, if necessary, repaired.

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CONSTRUCTION

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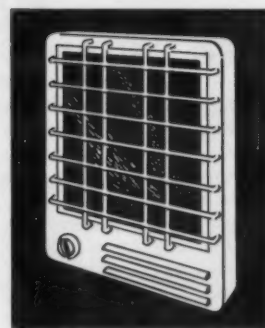
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If you are interested in using these PYREX E-C panels as components in new heaters, we'd be delighted to talk it over with you.



Standard panel sizes: 8" x 36", 12" x 16" and 16" x 24" are available. Other sizes to order.



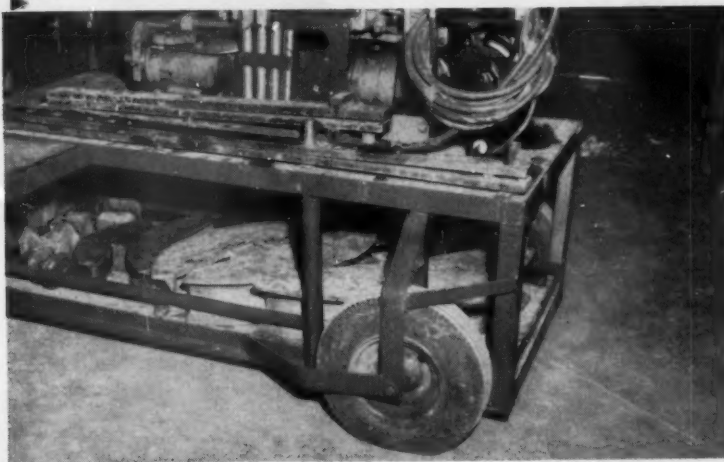
CORNING GLASS WORKS, CORNING, N. Y.

99 Crystal Street

Corning means research in Glass



THREE-WHEEL CART combines hydraulic bender mobility and storage with portable bending table. Note straddle-mounted motor driven hydraulic pump above ram and drop-leaf extensions on platform to support removable bender frame. One man can move unit with comparative ease.



BOTTOM PLATFORM of cart stores bender accessories and "one-shot" shoes for conduit sizes 2-in. to 4-in. diameter. Note balloon tire wheels for dirt fill buoyancy and pulling ease.

can be moved easily from one installation point to the next.

A good example of this type of equipment is the heavy-duty hydraulic conduit bender. It is bulky, heavy and awkward to handle. Some contractors place it on a conventional hand truck to move it around. Others design and build special carts or trucks for the units. In this latter group is Hatfield Electric Company, large electrical construction firm in Indianapolis, Ind.

Hatfield's mobile unit consists of a 3-wheel, steel-frame, cart with two wood platforms. The top platform is about 24 inches above floor level, 30 inches wide and 63 inches long. It supports the assembled bender with

its hydraulic power unit bracket mounted, piggy-back fashion, above the bender ram. The unit is V-belt driven (two belts) by a 2 hp, 110/220-volt, 1750 rpm, single-phase electric motor mounted directly behind the ram. This arrangement keeps the length of the cart to minimum dimensions.

Two drop-leaf extensions at the front of the cart increase the effective width of the top platform when the bender shoe assembly is attached. Each wood extension is reinforced by a 17½-in. by 20-in. rectangular steel frame hinged to the cart platform. In the "up" position, these "leaves" support the bender shoe bars. When

dropped, they "fold" against the side of the cart.

Just five inches above floor level is the bottom platform of the cart. Also of wood, it provides storage space for bender accessories and "one-shot" shoes for 90-degree bends in conduit ranging from 2-in. to 4-in. diameters. Pneumatic balloon tires on the wheels contribute to hauling ease over either paved or dirt floor areas. And an offset-handle on the front pivot-wheel permits one man to move the cart around with comparatively little effort. Four of these bender carts are now in the Hatfield shop and others may be added as the occasion demands.

Pre-Fab Conduits Cut Roughing Time

WIRING

Several significant labor-consuming details were eliminated by a technique employed by foreman Max Allen of Boro Electric Installations on a recent New York apartment house construction job.

Normally, during the course of installing conduits and boxes before the concrete pour, a separate cut-and-thread operation must be performed for every conduit terminal. This means that tools must be transported about the job as work progresses and, if power tools are to be used, temporary wiring must be installed and continually relocated to follow the course of the work. On most projects this means additional lost time walking back and forth from the threader and often waiting for another mechanic to finish using it.

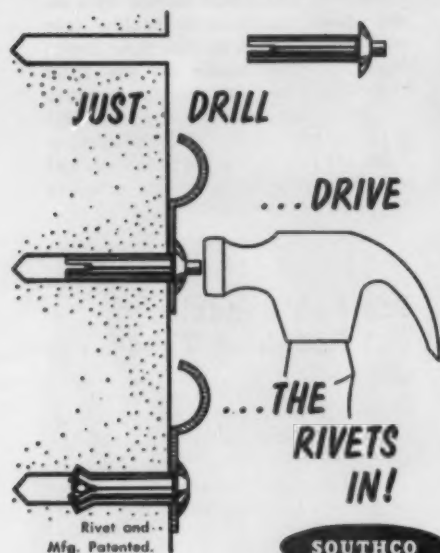
Foreman Allen broke this bottleneck to efficiency by having all cutting and threading done in the basement. Conduits were cut and threaded in lengths graduated from one to nine feet, then delivered to the working level. This enabled him to make full use of the benefits obtained from mass-production methods: men doing one simple operation are more productive than others involved in several different operations.

At the installation point, the mechanic had only to measure the length of a run and, if it came to 14½ feet, he made up a full length and a pre-cut 5 ft piece of conduit; by making a slight offset at a convenient place on the conduit run, he could "lose" the extra six inches.

Since many conduits had to be turned up or down from the slab to provide for base receptacle and switch outlets, Allen had his basement prefabrication team make identical

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Write for full details. Southco Division, South Chester Corporation, 254 Industrial Highway, Lester, Pa.

SOUTHCO

FASTENERS

Whenever two or more parts are fastened together.



SHORT CONDUIT LENGTHS are cut and threaded with basement-located power tools then delivered to working level. Lengths are graduated in one-foot steps. These offset conduits will be used for base receptacle outlets; similar straight pieces have been made for ceiling outlets.

right angle bends in a certain number of the pre-cut short lengths and some full lengths as well. The length of the bend was calculated to bring base outlets to the specified distance above the finished floor. Handling this part of the job at a central spot assured uniform bends and, because a power bender could be profitably and effectively used in the basement, an additional saving in labor was achieved.

Leftovers do not constitute a major problem in this technique. Several bundles of each size were made up originally, then as the shortages in various sizes occurred, the pre-fab team would turn out replacements. As Allen said, "By the time we get to the top (16th) floor, we'll know just what we need to finish it out even."

The effectiveness of the method is proven by the fact that only one or two conduits had to be cut on each floor level.

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Electric Units Solve Plant Heating Problem

SPACE HEATERS

The S. E. Massengill Company, Bristol, Tenn., manufacturers of pharmaceuticals, faced a serious heating problem when they constructed a new manufacturing and shipping building. Their steam plant was already operating at capacity and could not take care of the additional space heating load. Massengill's solution was the installation of space-saving electric unit heaters.

A total of 100 electric unit heaters, each 15 kilowatts capacity, were installed in the six-story building to heat a total of 1,418,640 cubic feet. Three of the floors (first, fourth, fifth and part of the third) are devoted exclusively to manufacturing and packaging

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Automatic Reset
for 20-watt Lamps
NEW ROBOT COP FS2-NA

Now you can enjoy the excellent automatic reset advantages of the famous Sylvania ROBOT COP (cut out premium) with 20-watt lamps. The new FS2-NA is the latest addition to the famous Sylvania line of starters that cut the lamp out automatically when lamp fails or voltage falls too low . . . and automatically cut the lamp in again when the trouble is cleared.

Sylvania ROBOT COP starters are available for use with standard-start fluorescents from 20 watts through 100 watts.

Three suggestions for service satisfaction

1. Where low-voltage conditions are a recurring problem—fully automatic Sylvania ROBOT COP starter.
2. Where the flicker of failing lamps is a problem—Sylvania COP Manual reset.
3. For the finest in standard starters—Sylvania Glostat starter.

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Folder WD 419, Sylvania guaranteed Fluorescent starters,
and information on the new FS2-NA ROBOT COP Starter.

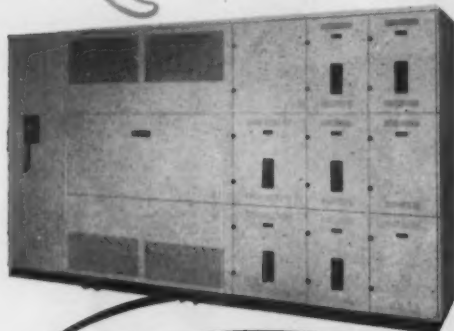
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Company _____
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"It ain't tin!"

... says the man who installs a

NELSON UNIT SUBSTATION



Nelson unit substation with incoming load break interrupter switch, 500 kva air-cooled transformer and low voltage main and branch breakers.

To protect the fine components that form the operating heart of a Nelson unit substation, we build heavy-duty steel enclosures that are strong and solid throughout. Extra-heavy steel channels provide a firm base for the assembly.

Nelson unit substations are manufactured with air, oil or non-inflammable, liquid-filled transformers; and, built integrally with these transformers, are Nelson switchgear, motor control centers and all-in-one substations.

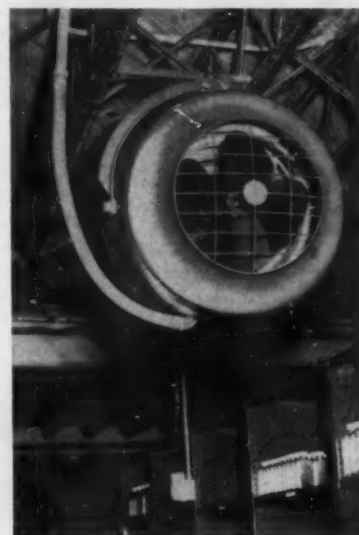
Maximum voltages from 13,800 volts primary to 600 volts secondary.

• Write for literature

NELSON *Electric* MANUFACTURING CO.
TULSA, OKLAHOMA



ELECTRIC UNIT HEATERS in the wrapping department at the Massengill plant are spotted next to outside walls, circulate warm air around building perimeter to maintain 72 degree over-all temperature. Same layout is used on all six floors.



CLOSEUP of unit heater, in a bin storage area, shows fan which pulls air over finned-type tubular electric heating units. Each unit heater is rated at 15 kilowatts; has a flexible electrical connection to permit alignment of unit for desired directional air flow.

operations. The remaining area is used as warehouse space.

The units were installed around the inside perimeter of the building, next to the outside wall, in such manner that the heater fans circulate air continuously around the inside walls of the building. This air completely encloses the center of the area, giving an even 72 degrees heat throughout the entire floor.

Prior to the construction of a Navy plant by Sperry-Farragut in Bristol, the Massengill building reportedly comprised the largest cubic footage electrically heated in the United States.

a new, superior system of CABLE and TUBING race ways GLOBE'S CABLE WAY

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A completely engineered system of cable ways, production produced and die formed for uniformity with up to twice the strength of ordinary trays, by actual laboratory tests. The universal splice plate joins all parts through the side channels only. All curved fittings are joined at the end of the radius (no tangent material is required) permitting continuous curves. This feature provides greater flexibility of application in tight places and creates an endless variety of combinations for a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings.

Comes in 6", 12", 18" and 24" widths, in standard 12' lengths to further speed up installation time. Cable way can be cut to length at any point—insides and bottom always smooth—all sections punched for easy installation—perfect fit at all times. Neat, clean and uniform in appearance.

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Electric Space Heating In Hazardous Locations

INSTALLATION

Unless some type of heating is provided, it can get mighty cold for employees working in gate houses, guard houses, loading dock offices and other outbuildings located some distance from a main manufacturing building. General practice is to provide a self-contained heating unit of some type or a unit connected to the central heating system. By far the simplest approach is to plug in an electric space heater to circuits already needed for lighting and other purposes. Use of electric heating for such applications is increasing, particularly where the area is small.

What apparently is a simple problem becomes somewhat complex when small buildings of this type are located in hazardous areas—such as oil and gasoline refineries, bulk loading stations and other industries where explosive atmospheres may exist. Conventional electric space heaters cannot be used since all electrical equipment and wiring in the building must be of an explosion-proof design approved for the hazard encountered.

Standard Oil Company (Indiana) solved this problem by installing explosion-proof electric space heaters in such locations; found this method more practical and economical than installing long connecting lines to central heating systems.

The installation at Standard's bulk loading station in Sauk Centre, Minn., is typical of those found in other Standard properties. Here, two 2-kw explosion-proof, 480-volt electric space heaters, rated Class 1, Group D, are installed side-by-side in the small office on the loading dock platform. Heating elements in these units are encased in fin-type aluminum castings mounted vertically in front of a metal reflecting surface to provide a combination of radiant and convected heat.

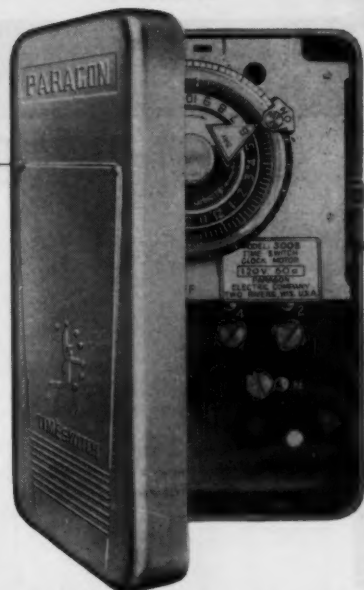
On time... day after day!



**Busy contractors
who must be right
the first time install**

PARAGON

3000 series time switches

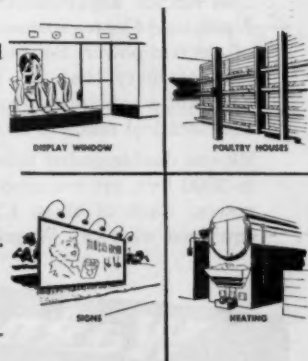


With the 3000 series "Memory Master" on the job — you can forget about profit-robbing service call backs. That's how dependable it is, day after day, for sign board and store illumination . . . poultry house lighting . . . industrial heating and scores of other plant operations.

Figure the 3000 series for every job where a 24-hour "ON-OFF" time switch is needed. Once the 3000 series is installed — just set it and then forget it! And you'll be *right* the first time . . . *profit* all the time!

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- Spring clutch dial drive — easy manual check of switch settings.
- "Quick-out" movement — positively fastened.
- Motor operating indicator.
- Double-plate, long-life movement.
- Oversize terminal screws for easy wiring.
- Easy-to-remove, dust-tight knock-outs pierced all the way through case.
- U.L. approved for 30 amp. switch capacity at 120 or 240 volts.



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WORLD'S FOREMOST MANUFACTURER OF TIME CONTROLS

Wagner®
TRANSFORMERS
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These metal clad substations are installed in the basement of the Hudson Building for 4800—208Y/120 volt lighting distribution.



world's most power-full shopping center

Northland Center development of The J. L. Hudson Company for suburban Detroit, 161 acres of convenience, offers shoppers merchandise and services ranging from clothing to food, furnishings, drugs, dry cleaning, barbering and banking.

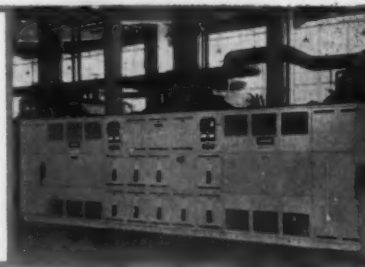
The branch department store and some 80 other Northland Center stores are tremendous consumers of electric power. So great is Northland's demand for electricity that the Detroit Edison Company has built a substation there large enough to supply the electrical needs of 25,000 homes.

Eleven double-ended substations, rated from 1000 to 2000 kva, are required to distribute this electric power. Each of these I.T.E. Unit Substations is equipped with two Wagner dry-type transformers.

Wagner Transformers play an important part in supplying power to many major businesses and industries. You'll find them where, as at Northland, only the finest equipment has been installed.

Let a skilled Wagner engineer discuss your transformer needs with you. Call the nearest of our 32 branch offices, or write us.

Unit Substation installed in Utility House for 4800—480 volt power distribution.



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DATA SHEET

Conduit Spacings

SPACINGS IN INCHES BETWEEN CENTERS OF CONDUITS

The light face figures are the minimum dimensions to provide clearance between locknuts.
The more liberal spacings printed in bold face type should be used whenever possible.

Size	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	6
1/2	1 3/4	...	...	...	...	...	...	...	...	...	...	...	...
3/4	1 3/4	1 3/4	...	...	...	...	...	...	...	...	...	...	...
1	1 3/4	1 3/4	1 3/4	...	...	...	...	...	...	...	...	...	...
1 1/4	1 3/4	1 3/4	2	...	...	...	...	...	...	...	...	...	...
1 1/2	1 3/4	1 3/4	2	2 1/4	...	...	...	...	...	...	...	...	...
2	2	2 1/4	2 1/4	2 1/2	...	...	...	...	...	...	...	...	...
2 1/2	2 1/4	2 1/4	2 1/4	2 1/2	2 3/4	...	...	...	...	...	...	...	...
3	2 1/4	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	...	...	...	...	...	...
3 1/2	2 1/4	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	...	...	...	...	...
4	2 1/4	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4	4 1/4	...	...	...
4 1/2	2 1/4	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4	4 1/4	4 1/2	...	...
5	2 1/4	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4	4 1/4	4 1/2	5	5 1/2
6	2 1/4	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4	4 1/4	4 1/2	5	5 1/2

APPROXIMATE DIAMETERS

Locknut.....	1 1/4	1 3/4	1 1/2	2 1/4	2 3/4	3	3 3/4	4 1/4	4 3/4	5 1/4	6	6 1/4	7 1/4
Bushing.....	1	1 1/4	1 1/2	1 3/4	2 1/4	2 3/4	3 1/4	4 1/4	4 3/4	5 1/4	6	6 1/4	7 1/4
Conduit.....	3/4	1 1/4	1 1/2	1 3/4	2 1/4	2 3/4	3 1/4	4 1/4	4 3/4	5 1/4	6	6 1/4	7 1/4

Maximum Distance for Wire Runs Without Raceway Support

Wire Size	Not Greater Than (Feet)	Wire Size	Not Greater Than (Feet)
# 18 Awg to # 0 Awg	100	# 350 MCM to # 500 MCM	50
# 00 Awg to # 0000 Awg	80	# 500 MCM to # 750 MCM	40
# 250 MCM to # 350 MCM	60	# 750 MCM and above	35

Courtesy Pittsburgh Standard Conduit Co.

In The News

Floods Soak Wiring Over Six-State Area

Still badly battered, yet doggedly fighting their way back to normalcy, are six of our northeastern States which were disastrously flooded August 19th and 20th by a savage cloudburst having no parallel in the records of the Weather Bureau.

Spawned in a 300-mile-wide low-pressure trough plowed by Hurricane Diane, and extending from Pennsylvania well up into Massachusetts, this raging storm created disaster areas in vast sections of these two states as well as in New Jersey, New York, Connecticut and Rhode Island, where up to 19 inches of water fell during a 24-hour period.

Coming without warning and with fury usually confined to the tropics, this sneak punch converted placid streams to turbulent raceways within the span of a few hours, and devastation was overwhelming in steep-sloped valleys such as those stretching along the Delaware, Naugatuck and Connecticut Rivers.

With these river valleys heavily industrialized and heavily populated, death and destruction were the greatest in over a century. Property damage was estimated above the \$3-billion mark, known dead exceeded 200, and an additional hundred people were still unaccounted for weeks after the flood had subsided.

Especially battered were areas around Stroudsburg, Pa.; Branchville, N. J.; Port Jervis, N. Y.; Waterbury and Winsted, Conn.; Worcester, Mass.; and Woonsocket, R. I. Yet many other cities were clobbered as well; some being isolated by washed-out bridges and telephone lines, others left without power or drinking water, still others turned into shambles of demolished houses, ripped pavements, smashed cars and slimy silt eight feet deep in places.

Personally inspected by President Eisenhower, this six-state flood-stricken area revealed other dangers as well; such as contaminated water, menace of typhoid, polluted food, looting and fire.

To combat these spectres, the Red Cross promptly allocated \$2-million for immediate medical, sheltering and feeding purposes; our President released \$80-million from his emergency fund, and a national radio plea to the public solicited an additional \$8 million to meet the wants of 34,000 homeless

families. National Guardsmen were called out to install temporary bridges, detour traffic away from washed-out roads, and to protect property. Civil Defense volunteers helped with evacuation and inoculation assignments. Helicopters went into action to disperse food and pick up survivors in cut-off communities. Rescue teams also used amphibious ducks, boats and heavy trucks to evacuate other stranded civilians. Temporary hospitals and morgues were set up to care for the injured and the dead.

A week after the storm, all rivers had returned to their normal channels. Yet nature's brief, violent tantrum had devastated farm crops, staggered business and hog-tied industry.

In electrical terms, the aftermath revealed disrupted utility lines, countless silt-packed switchgear assemblies and bus structures, saturated insulation on motors and wiring, jammed control devices, contaminated contacts, and burned-out equipment everywhere.

Electrical contractors and motor shop operators suffered damage comparable to that of business at large. Yet many companies so affected promptly went to the aid of others, even before fully assessing their own losses. Scores of service organizations in adjacent, unaffected areas also pitched in to speed this mammoth salvage operation. Some contractors shifted engineering departments and supply depots to new quarters to expedite service, and many motor repair outfits set up temporary or auxiliary shops, working round-the-

clock to help industry struggle upwards on wobbly legs.

During this rehabilitation period, most contractors, motor shops and industrial maintenance departments based their procedures upon experience of others, gained previously during such water-damage disasters as the Missouri and Kansas River flood (EC&M, Aug. '51) and New England hurricane (EC&M, Octo. '54). In this present instance, however, damage and

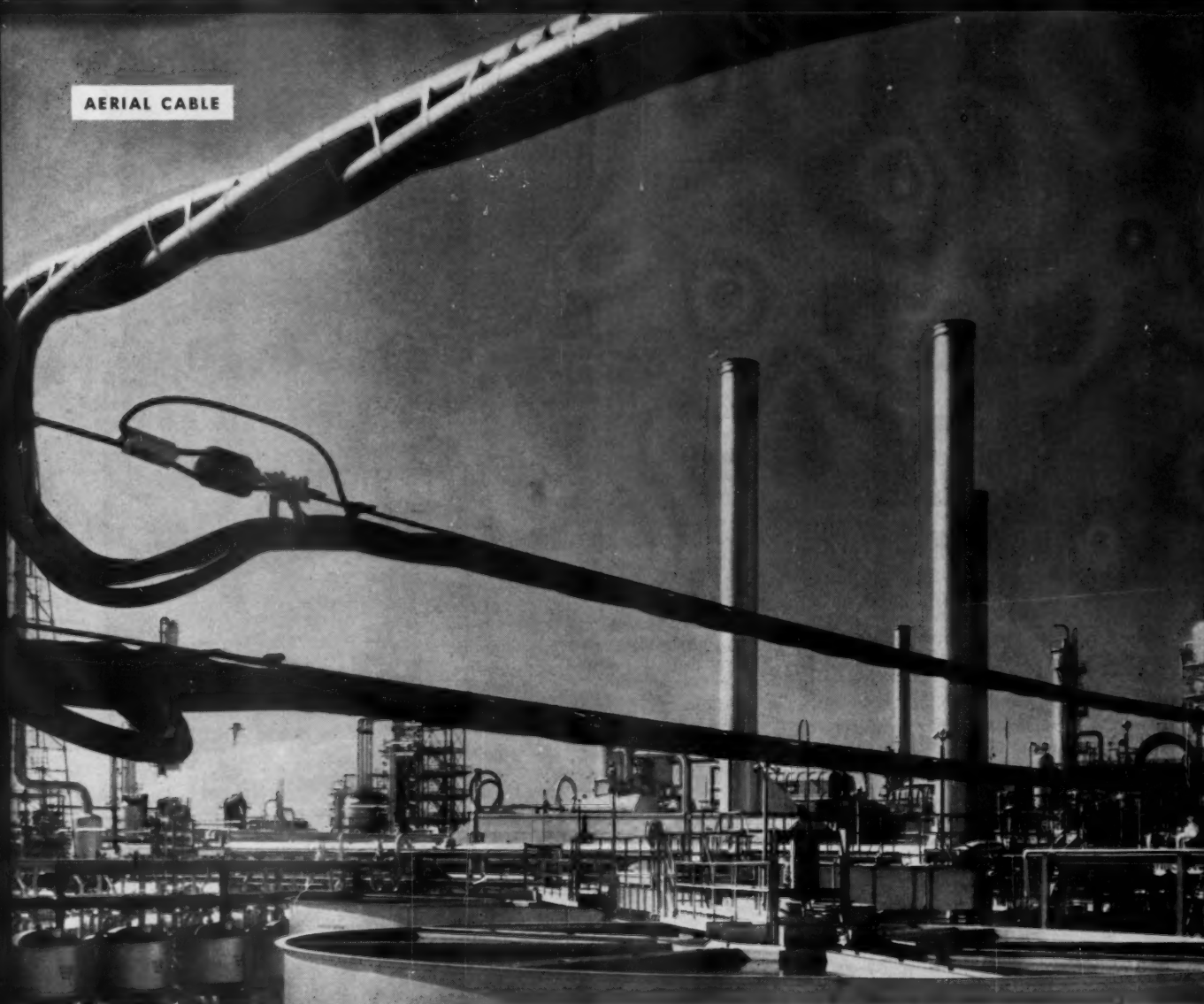


AIR DELIVERY of motor stator during emergency shut down pleases G. Richards (left), chief electrician, Oregon Pulp and Paper Co, Salem, Oregon. J. C. Reed (right), Reed Electric Co, Portland, uses his private plane to speed service to his motor shop customers.



WIRING HUDDLE finds (L to R) contractor Harold W. Stack; chief electrical inspector James Paxton and contractor Morry H. Johnson, all of Spokane, Wash., discussing progress of the new residential 200-amp service entrance expandable wiring requirement of new city electrical code. Entire Spokane electrical and building industry supported the new rule.

AERIAL CABLE



NEITHER STORM NOR HEAT NOR CORROSION knocks out ANACONDA's 3-conductor 15kv self-supporting Aerial Cable—shown here at Shell Oil's modern new refinery at Norco, La.

GO UP TO BRING COSTS DOWN

—with Anaconda Aerial Cable

When new power is needed or when old circuits must be replaced quickly and at low cost—more and more plants are turning to ANACONDA Aerial Cable.

In plants where the maze of pipes and other underground structures often make installation of ducts or buried cable costly or difficult. This

cable solves the problem.

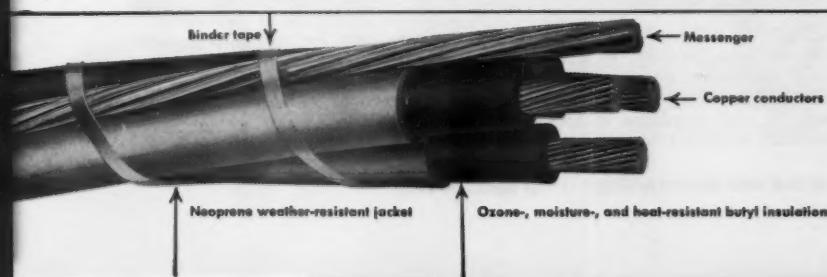
It's fast, easy to install—particularly in crowded areas. No special ducts or crossarms or insulators are needed. Even in open areas, this rugged, neoprene-jacketed cable costs much less than buried systems.

You can see that it is neat. It is

equally safe . . . and reliable!

Today's finest aerial cable! Type AB butyl insulation gives ANACONDA Aerial Cable the finest performance record. For the full story, call the Man from Anaconda today. Or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

A3070



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LIGHT WHEN YOU WANT IT... WHERE YOU WANT IT

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- ★ No installation costs. Just hang up, plug in!
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DIVISION OF THE VACUUM CLEANER CORP. OF AMERICA
1724 INDIANA AVE., PHILA. 32, PA.

reconditioning work was far more extensive, while methods and equipment used by various salvage crews revealed wider ranges of ingenuity and necessity.

For example, methods for removing fallen trees and debris from primary power line routes varied from the use of gas-driven chain saws, truck winches, bulldozers, hydraulic elevated platforms and diesel-powered derricks, to basic manual use of 2-man saws, blocks and tackle, pruning poles and axes. The cleaning of controls, bus ducts and conduit runs involved the use of fresh-water sprays, steam, compressed air, carbon tetrachloride and various naphtha products. Drying methods included the use of conventional ovens, portable infra-red lamp banks, plus unit oil and gas heaters under an assortment of field-constructed hoods. In addition to cleaning and drying, hundreds of motors required new insulation, while countless units (such as breakers, starters, meters and controllers) had to be removed for thorough reconditioning before being replaced in service. Where power continuity was imperative (such as for hospitals), mobile motor-generator sets were trucked in from outlying supply points, and auxiliary transformers were brought in to maintain emergency service. Residential customers received service related to sump pumps, oil burners, refrigeration, air conditioning and lighting.

As to the supply of essential equipment (such as wire and cable, splicing sleeves, tape, insulators, new motors, transformers, controls and the like), widespread cooperation was obtained from wholesalers, manufacturers, util-

ity companies, contractors and motor shops alike; stocks from all these interests being made available to all for the common good.

Cooperation was evidenced between competitive companies, union and non-union labor, plant maintenance personnel and utility linesmen, all of whom worked shoulder to shoulder in this across-the-field rehabilitation project.

Since time was precious and extent of damage was problematical, most work was performed without estimate, working on a time-and-material basis yet keeping initial repair work as minor as possible without violating



QUICK SERVICE is the motto of Gordon O. Toms, motor repair shop owner at Spokane, Wash. Flying his own 4-place, single-engine plane for the past eight years, he has logged more than 1800 hours flying time, most of it on business and emergency calls—anytime of day or night—to customers within a 200 mile radius. Most saw mills in the mountainous area have their own air strips for this type of emergency service, he reports.



INSPECTING NEW supplementary electric heating unit for use with conventional furnaces are (L to R) Curtis Van Dervert, Banner Furnace Co; G. Glen Crewse, contractor, and Frank Corigliano and Ken Henker, Franks Electric, all of Spokane. The 3.9-kw unit was developed by A. V. Martin of the Washington Water Power Co and introduced to Spokane electrical contractors at a special WWP contractors breakfast meeting.



"DOCTOR" HARRY WETMORE, assistant shop superintendent, California Electric Co., Oakland, detects harmful bearing noise in a motor under test. Instrument, a motor stethoscope or multiscope, used for sound analyses and diagnosis is a handy piece of motor shop equipment.

standards of safety, adequacy, permanency or practicality.

Scars from this disaster will be evident for years. Many companies (not covered by insurance against flood or hurricane damage) will cease to exist. Other plants (inundated or swept away completely) face the back-breaking and discouraging task of rebuilding. Yet, on the plus side of the ledger, the disaster has spurred reconsideration of long-needed flood control; it proved that an entire section of our country can take a violent body blow without collapsing, and it demonstrated that a common tragedy instantly unites those normally separated by trade, competition and similar personal-interest barriers.

Action Endorsed by Electrical Coordinating Group

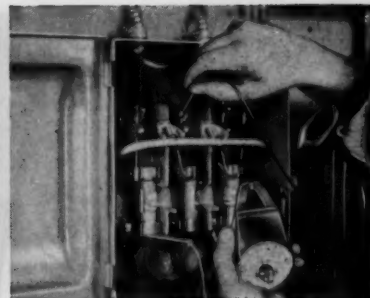
Strong endorsement of ACTION'S program was voiced by Chairman J. Reed Hartman for the Electrical Industry Coordinating Group at a press conference in New York on August 16.

The American Council to Improve Our Neighborhoods, called ACTION, is sponsoring a national program for housing improvement in what is expected to be the biggest surge of slum clearance, remodeling and rehabilitation in American history.

According to ACTION researchers, there are about 5 million non-farm dwellings which are rock-bottom slums. Another 20 million are in need of major repairs. The remaining units, though still in good condition, need



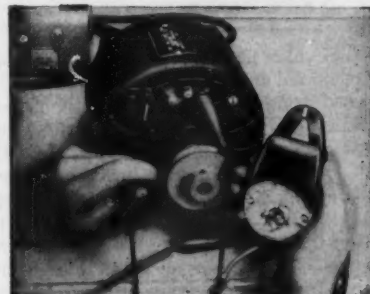
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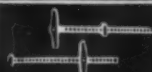
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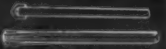
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REWRITING PORTLAND city electrical code is an editorial chore tackled with gusto by Joseph F. Gray, Portland's chief electrical inspector. Gray writes his rules with an eye for clarity to eliminate multiple interpretations. New code will be based on the latest NEC edition, with upgrading where needed to meet local conditions. The revised code, expected to be ready by January 1956, will probably make 200-amp meter sockets and service entrance conduit mandatory for new residential wiring.

regular upkeep if they are to be conserved and protected.

About \$10 billion in electrical work is necessary to bring existing substandard housing up to a safe minimum. This estimate includes approximately \$1 billion for improved street lighting. The figures are part of the \$100 billion that ACTION research considers necessary to stop blight and eliminate slums during the next ten years in addition to current expenditures on housing and repairs.

Electrical industry representatives pointed out that success of the ACTION program will have tremendous effects on the electrical industry, far exceeding the \$10 billions for new wiring. Elimination of substandard wiring will greatly increase the demand for electrical appliances and power.

"Members of the electrical industry," said Mr. Hartman, "have an excellent opportunity to invest in the future prosperity of their business and the future well-being of the nation by supporting ACTION."

NISA News

Romanoff's Electric Motor Service Inc. of Toledo will move shortly into a 3-story building at 960 West Central Ave. which the firm purchased on June 20.

Newly elected national vice-president, Charles J. Covington, Dowzer

Electric Machinery Works, Inc., Mt. Vernon, Ill., recently passed final tests for his pilot's license and is a full-fledged pilot.

An invitation to all NISA members has been extended by the Niagara Chapter to its annual picnic to be held at Hotel Marcy, Lake Placid, N. Y. the weekend of Sept. 17-18. Scheduled activities begin at noon, Sept. 17, including a boat ride on Lake Placid, cocktail party and dinner that evening with a business meeting to follow.

Louisville Chapter elected Bernard M. Smith of Marine Electric Co., Inc. to be its president for the coming year. Vice-president is George M. Ruf of J. George Electrical Co., Inc.; Secretary, J. W. Ruf, the same firm, and treasurer, Ed Krauth of Wm. C. Krauth Electric Co., Inc.

The New York Metropolitan Chapter plans to revive its foreman's meeting, holding it in February or March of 1956. The chapter's new award contest conducted this year for the first time will be held simultaneously.

Frank Ortega Jr. of Frank's Electric



KEN KOLSTAD, president of K & R Electric Service in Alfred Station, N. Y., just had the pleasure of completing the wiring in a deluxe dream house where the main directive was to "provide modern, convenient, comfortable electrical living" for the home owner. Low voltage relays, remote control of lighting via an automobile transmitter, dimmers and radiant heating were a few of the resultant mediums employed towards this end. The letters of Kolstad's organization, K & R, means "Ken and the Rest"—for those who wonder and ask—as we did.

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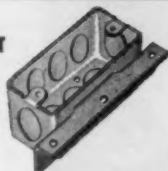
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In 1/2", 3/4" and 1".
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PROMINENT PORTLAND electrical contractor W. R. Grasle, Sr., president, W. R. Grasle Co., believes present wave of low-bidding is due to over extension of contractors into work unfamiliar to them. As vice president of NECA District 6, he spent most of his time this past year visiting electrical contractors in the western states.

Co. is the new president of the Youngstown Chapter. Meeting at Colonial House May 10, the group also chose the following officers: secretary-treasurer, Jack Winkle of Winkle Electric Co.; reporter, George D. Rose of Electric Motor Service Co.

• • • • •

Forty-one were reported present at the meeting of Quaker City Chapter held at Beck's on the Boulevard Restaurant. New chapter officers, elected at the meeting were president, Ralph O. Kufen of Kufen Electric Motor and Engineering Co., Hatboro, Pa.; vice-president, Robert S. Swanson of Electric Motor Service, Kennet Square, Pa.; treasurer, C. R. Durand of H. N. Crowder Jr. Co., Allentown, Pa.; executive committee, A. Albertson of A. Albertson & Son,



EARLY BIRDS Ed Collins (left), superintendent, and Robert C. Wright, sales manager, Maxwells, Inc., Spokane electrical construction firm, attend early morning contractor breakfast to learn about newly announced supplementary electric heating unit for use with conventional hot air furnace heating systems.

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provide modern • clean • controlled heat
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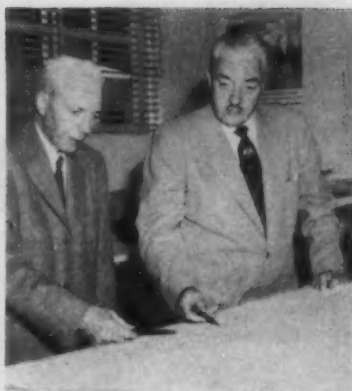
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TIME OUT from executive duties is taken by (L to R) A. A. Tobey, secretary-treasurer; and S. I. Jaggar, president, Jaggar-Sroufe Co; Portland, Oregon, electrical contractors, to check engineering details on electrical plans. Both favor good engineering and accurate estimating practices.

Red Hill, Pa., Thomas Marino Jr. of Marino Electric, Philadelphia, Pa., and James Previty of Penn Electric Motor Co., Philadelphia, Pa.

Following elections, representatives of Socony Vacuum discussed lubrication of rotating electrical equipment.

• • • • •

New England Chapter met at Hotel Bradford, Boston, July 14, to hear reports from members who attended the Los Angeles Convention and continue a discussion of motor repairs started at the group May meeting.

• • • • •

Frank W. Willey of Cincinnati became the fourth to sign up for NISA's newest membership classification when he applied for privileged membership effective



CHARLES MICHAELS combines mechanical and electrical know-how to make his Brooklyn, N. Y., firm a strong factor in the field of heavy industrial electrification in the metropolitan New York area. The Charles Michaels, Inc. sign is also displayed on many Utility and public works projects where engineering ability is an important consideration.

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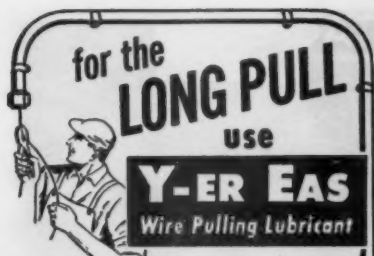
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SCHOOL WIRING has been a major item on the recent work schedule of the Bartoli Electric Co., Norwalk, Conn. Going over the plans of Norwalk's new Nathan Hale Jr. High School are (L to R): Frank Bartoli, Sr., president; Donald Radman, estimator; and Frank Bartoli, Jr., vice president.

tive May 1, the first day of his retirement.

• • • • •

Edward G. Potter of Lima Armature Works, Lima, Ohio, and a past national director of NISA, was elected first vice-president of Lima Rotary Club.

From Walter J. Prise, Queens Electric Motors, Inc., Jamaica, L. I., N. Y.

National Electrical Industry Show Next Month

When the 3rd National Electrical Industry Show opens at the 69th Regiment Armory in New York next month, October 11-14th, it will be a larger and "better than ever" show,



POWER CITY Electric Company partners Ray J. Johnson and E. B. DeFeyer operate an electrical construction organization that runs the gamut from transmission lines and power plants through industrial and commercial projects to community TV antenna systems. With headquarters in Spokane, Wash., the firm operates in a 4-state area.

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ESTIMATORS Larry Weaver and Bill Bachem, Agutter Electric Co, Seattle, Wash., check over electrical plans on a government project. A substantial portion of Agutter work is in Alaska area.

according to Harold Meyer, producer.

150 Manufacturers will display more than 35,000 products keyed to better electrical living. These manufacturers represent 50 major cities and more than 30 states across the nation, greater national representation than the two previous shows. The exhibits are expected to attract buyers, contractors, electrical distributors, builders, purchasing agents, lighting engineers, etc. from all over the nation and from several foreign countries.

One of the highlights of the show is the Electrical Installation Contest for contractors. The contest has attracted national interest, and entries have poured in from many important contractors across the country. Three awards will be made for first, second and third place selections of "outstanding electrical installations of the year."

Many of the exhibits will feature



ON THE JOB, city electrical inspector G. W. Bigger (right) checks an electric heating distribution panel installation in a Spokane, Wash., home. Electrician L. A. Billings, D. G. Quinton Electric Co, gives the inspector an assist.



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REED BROTHERS, John C (left) and LeRoy A., Portland, Oregon, operate their enterprising motor repair business 24 hours a day to give customers best service possible; and air delivery of equipment and parts in emergencies. The young repair specialists favor production line techniques and are constantly devising new methods to improve workmanship and service.

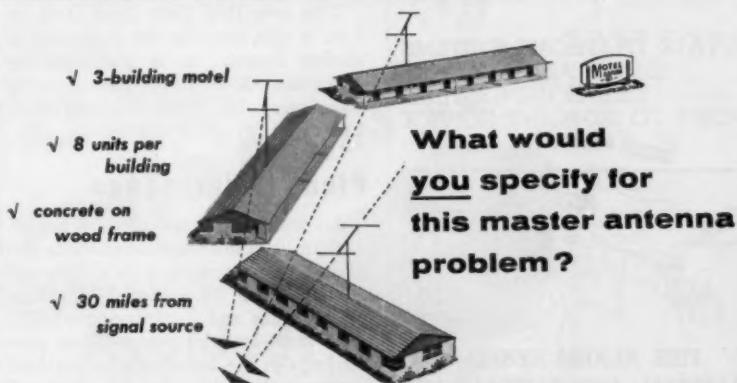
products with built-in safety in keeping with the "Safety Through Adequate Wiring" theme of the show. Consolidated Edison, Electrical Associates Club of New York, and the National Adequate Wiring Bureau all plan special adequate wiring exhibits designed to help the contractors, buyers, builders, etc. instruct the public in adequate wiring desirability.

Book Reviews

Air Conditioning And Refrigeration

With air conditioning application and sales growing by leaps and bounds, there has also resulted an increasing growth of electrical loads to serve this added air conditioning, and of electrical maintenance to keep the cooling systems adequately powered at all times. Thus, the new "Air Conditioning-Refrigerating Data Book", Applications Volume, 5th edition, just out, will be of interest to most electrical men—consulting electrical engineers, electrical contractors, operating and maintenance engineers, architects, builders, and others.

The new edition contains 61 chapters, three of them new, and most of the others extensively revised to bring them up-to-date with latest practice. It includes design information, formulas, table diagrams, and sample engineering calculations in factual handbook style presentation. There are 343 illustrations and 104 tables.



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APARTMENT HOUSE PHONES
(BULLETIN 120)

HOSPITAL SIGNALING
(BULLETIN 125)

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GENERAL FOREMAN Ed Shirley, Collins Electric Company, Sacramento, Calif., explains electrical distribution closet layout in new State Employment Office building. Panel at right controls 277-volt fluorescent lighting system. Transformer for 120/208-volt receptacle circuits is above.

It was written by 89 authors and associate editors, selected for their experience and eminence in particular fields, to insure that each chapter is the consensus of those best qualified for the job. Harold M. Hendrickson, Associate Professor of the Dept. of Mechanical Engineering, University of Washington, was Editor-in-Chief.

This new 1955 Data Book is 6½ by 9 in. in size, contains 984 pages, and is leather bound. It is published by American Society of Refrigerating Engineers, 234 Fifth Avenue, New York 1, N. Y. Price is \$7.50.

Plant Maintenance

An unusually practical collection of modern plant maintenance methods and procedures is contained in a 218-page volume titled "Techniques of Plant Maintenance and Engineering—1955". This book includes the complete proceedings of the technical sessions held concurrently with the 6th National Plant Maintenance and Engineering Show which was held in Chicago earlier this year. All papers delivered at that conference are included, also the complete question-answer sessions following each presentation, plus comprehensive summaries of 16 roundtable discussions that considered special problems related to the maintenance field, likewise conducted during the Chicago Conference. Since all papers were prepared by outstanding authorities in their respective fields, the book represents a valuable reference source for those seeking workable solutions to a wide range of problems encountered in maintenance work.

This wide scope of subjects includes



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FLUSH STUBUP method used in lift-slab construction at Mark County Office Building, Sacramento, Calif., is pointed out by A. M. Kirkpatrick, general foreman for E. L. French, project electrical contractor. Conduit couplings have flush plugs which are replaced by nipple extensions later. Patching plaster in plug recess identifies stubup.

Control of Maintenance Activities, Planning and Scheduling, Cost Control, Organization of the Maintenance Force, Production Standards, Work Measurement, Training the Maintenance Workers, Advantages and Limitations of Planning and Scheduling, Selection and Indoctrination of Maintenance People, Communications between Management and Maintenance Personnel, Worker Motivation and Morale, Union Problems, and What Management and Maintenance Departments Want from One Another in the way of cooperation and contributions to production.

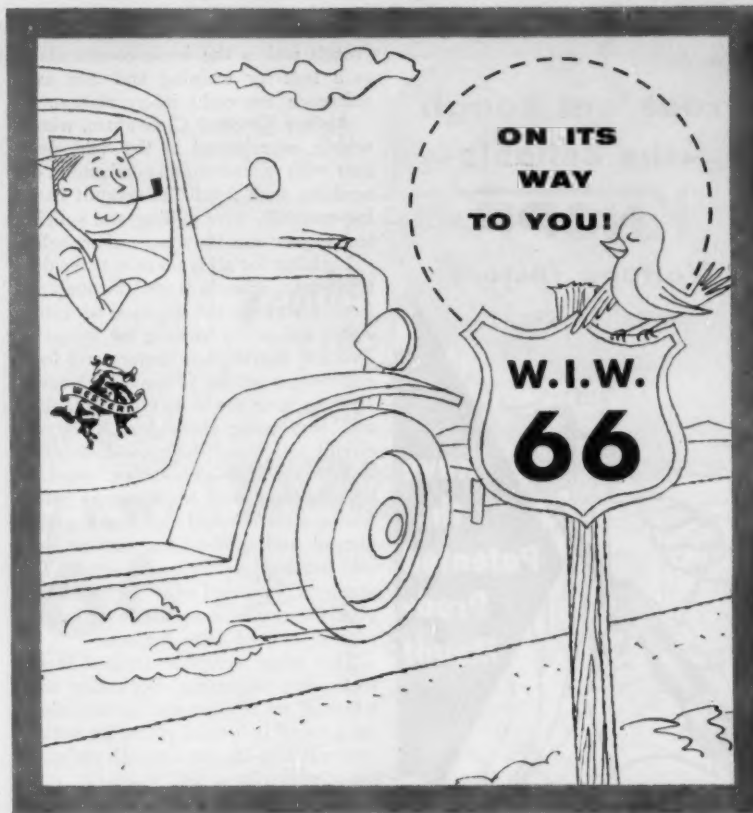
Roundtable discussions of specific interest to those in the electrical field include Electronic Control Equipment, Electrical Distribution Systems, Maintenance Stores and Storekeeping, Card Systems, Power Plant Equipment, Materials Handling Equipment and the use of Maintenance Manuals.

Published by Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y., this 218-page (8½ by 11 inches) book is priced at \$7.50

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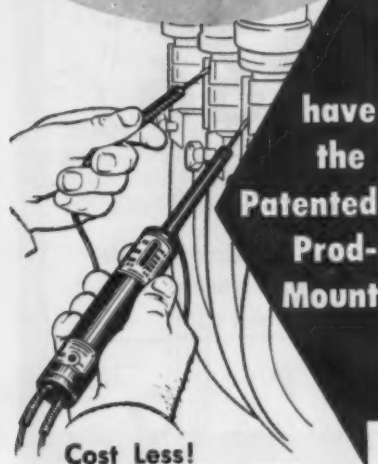
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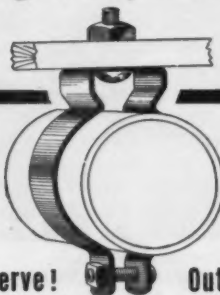
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Illuminating Engineering Society—National Technical Conference, Statler Hotel, Cleveland, Ohio, September 12-16.

International Association of Electrical Inspectors—Northwestern Section, Bellingham Hotel, Bellingham, Wash., Sept. 12-14; Southwestern Section, Mission Inn, Riverside, Calif., Sept. 19-21; Western Section, Nicollet Hotel, Minneapolis, Minn., Sept. 26-28; Southern Section, Jung Hotel, New Orleans, La., Oct. 3-5; Eastern Section, Mark Twain Hotel, Elmira, N. Y., Oct. 10-12; Canadian Section, King Edward Hotel, Toronto, Ontario, Canada, Oct. 21-23.

National Electric Sign Assn.—Annual fall conference, Sheraton Hotel, Chicago, Ill., September 15-16.

National Association of Electrical Distributors—Pacific Zone, annual convention, Empress Hotel, Victoria, B. C., Canada, September 25-28.

Electrical Progress Show—Convention Hall, Philadelphia, Pa., September 27-29.

National Electronics Conference—Hotel Sherman, Chicago, Ill., October 3-5.

Canadian Electrical Manufacturers Assn.—11th annual meeting, Sheraton-Brock Hotel, Niagara Falls, Ont., Canada, October 5-7.

International Association of Electrical Leagues—King Edward Hotel, Toronto, Can., October 5-8.

National Electrical Industries Show—69th Regiment Armory, New York City, October 11-14.

N. J. Council of Electrical Leagues—19th convention, Atlantic City, N. J., October 14-15.

National Electrical Contractors Association—Annual convention Waldorf-Astoria, New York City, October 31-November 4.

Fifth Industrial Electric Exposition—Hotel Wm. Penn, Pittsburgh, Pa., November 1-3.

National Electrical Manufacturers Assn.—Annual meeting Traymore Hotel, Atlantic City, N. J., November 14-18.

National Rural Electric Cooperative Assn.—St. Louis, Mo., January 23-26, 1956.

American Institute of Electrical Engineers—Winter general meeting, Hotel Statler, New York, N. Y., January 30-February 3.

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Electric Products Co., Cleveland, Ohio—W. A. Thomas and J. R. Williams, vice presidents.

Holophane Co., Inc., New York, N.Y.—Gene G. Rae, vice president, Controlens Division; E. L. Bodow, director.

Homelite Corp., Port Chester, N.Y., has been purchased by Textron American, Inc., of Providence, R.I.

Hi-Tender Co., Leavenworth, Wash.—William C. Polk, general sales manager.

General Electric Co., Schenectady, N.Y.—C. Benjamin Ramsdell and Bryce W. Wyman, managers of manufacturing for Low Voltage Switchgear Dept. and Power Transformer Dept.

Auth Electric Co., Inc., Long Island City, N.Y.—Douglas J. Rourke, sales manager.

Kenco, Inc., Lorain, Ohio has been acquired by American Crucible Products Co. of the same city.

Lighting Products Inc., Highland Park, Ill.—Eric H. Church, operations manager in charge of engineering and production.

Hyster Company, Portland, Ore.—Anthony A. Pack, assistant to the president.

Delta-Star Electric Div., H.K. Porter Co., Chicago, Ill.—Frank Soles, works manager for all plant operations.

Koppers Co., Inc., Wood Preserving Div., Pittsburgh, Pa.—J. W. Sullivan, assistant sales manager.

Sterling Electric Motors, Inc., Los Angeles, Calif.—Edgar K. Johnston, vice president; John R. Eastman, chief engineer.

Crouse-Hinds Co., Syracuse, N.Y.—John R. Tuttle, president and chairman of the board.

Simplex Electric Co., Chicago, Ill.—E. L. Jones, sales manager.

General Electric Co., Trumbull Components Dept., Plainville, Conn.—P. E. Eldridge, manager-industrial sales; J. D. Hopkins, Jr., manager-service entrance equipment sales.

Rome Cable Corp., Rome, N.Y.—Richard E. Gates, manager of conduit sales.

General Dynamics Corp., Electro Dynamic Div., Bayonne, N.J.—W. L. Pharmer, assistant sales manager.

Globe Lighting Products, Inc., Brooklyn, N.Y.—John H. Kelly, general sales manager of the residential lighting division.

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Miller Co.: Robert S. Rogge, cen-
tral regional sales manager; head-
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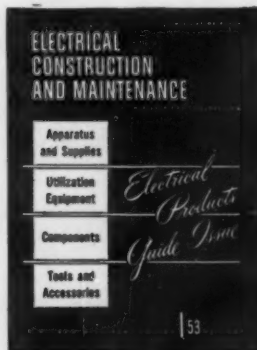
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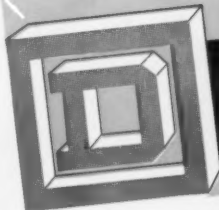


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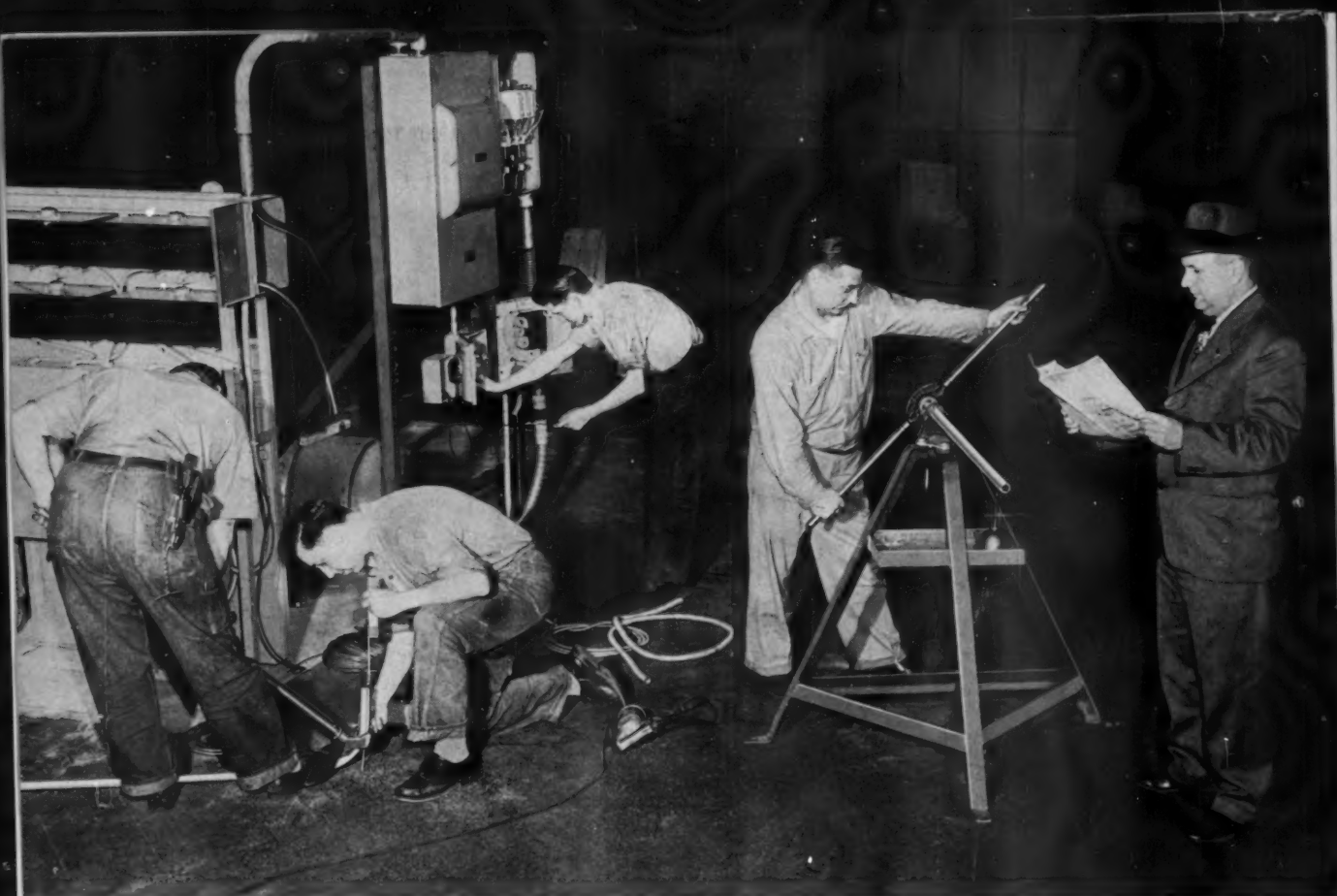
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Ask the man who installs rigid conduit and you'll learn why he prefers G-E White. Contractors, too, are finding that G-E White adds a substantial efficiency factor to their installations. It bends easier and threads easier than old-style conduit because galvanizing by metallizing eliminates processes which cause most conduit to harden. Wires pull more easily because the new organic coating on the inside contains a special anti-friction compound.

... and it offers outstanding corrosion-resistant advantages

G-E White rigid steel conduit stands up so well against corrosion, it provides assurance that the job you do today is planned for the future as well. G-E White is zinc-galvanized by metallizing, a process which bonds a uni-

form coating of pure zinc to the entire outside surface of the conduit, including threads. The interior surface is protected by a special organic coating. Exacting tests prove that the new G-E White offers improved resistance to corrosion from smoke, heat, humidity, acid fumes, alkalies, and salt atmosphere—both inside and out. The C-553 organic coating over the zinc retards white rust and gives extra protection against rough handling.

G-E White is one of many General Electric products designed to help electrical contractors in meeting the challenge of staying one jump ahead of tomorrow's electrical needs while keeping within today's economic limitations. For more information see your G-E Construction Materials distributor or write Section C55-918, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

Progress Is Our Most Important Product

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